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# ELETROCAUTERIZATION OF VENEREALWARTS: PRESENCE OF BIOAEROSOLS IN SURGICAL SMOKE[1]

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## ABSTRACT

**Objective:** to analyze the capacity of the bioaerosol retention filters with the use of a surgical smoke aspirator in procedures of cauterization of venereal warts. **Method:** field, descriptive, cross-sectional and quantitative research. The study was developed at a referral center for sexually transmitted infections in the northern state of Paraná, in the urology outpatient clinic. Data collection was collected from April to July 2016, with a sample obtained from 72 cauterization procedures. A descriptive statistical analysis was performed. **Results:** 24 filters attached in two equipment, used to vacuum the smoke were analyzed. The conventional Polymerase Chain Reaction method was used to read the filters, using specific primers to search for Simple Herpes, Herpes Zoster, Hepatitis C, Human Immunodeficiency Virus, Hepatitis B and Human Virus Papilloma. From the analyzed samples were found Viral Deoxyribonucleic Acid from Herpes Simplex, Hepatitis B and Human Virus Papilloma in the analyzed filters. **Conclusion:** the use of surgical vacuum aspiration equipment with Ultra-low Particulate Air filters during the cauterization of venereal warts was able to retain bioaerosols when the filter replacement time was respected.

**Keywords:** Electrosurgery. Occupational Health. Occupational Exposure. Biological Factors

## INTRODUCTION

Work is a primordial activity for the maintenance of the identity of individuals. Even being a source of satisfaction and financial gains, it can also lead to the sickness of the worker, due to the occupational risks to which they are exposed daily[1]. These risks can be categorized as physical, chemical, biological, ergonomic, psychic and social that influence the health and disease process abruptly or insidiously[2].

Health workers are also directly exposed to occupational hazards, with emphasis on the biological due to the performance of their work activities[2], being defined by the probability of occupational exposure to microorganisms, cell cultures, parasites, toxins and prions[3].

Among the several biological risk agents mentioned, the focus of this study was the exposure of the health worker to the surgical smoke that is generated in the electrocauterization of venereal warts. This smoke is formed when the electrocautery in contact with the tissue elevates the intracellular temperature to at least 100º C, thus causing tissue vaporization in the form of surgical smoke[4]. The use of electrocautery has its scientifically proven benefits, such as reduction of surgical time, less intraoperative bleeding and improved visibility during surgery[5].

On the other hand, the evidence on its harms for exposed workers is still little explored[6]. Electrocauterization can have harmful effects for patients and professionals, such as respiratory, ocular, dermatological, mutagenic and carcinogenic risks[4,7]. The Occupational Safety and Health Administration (OSHA) estimates that every year, about 500,000 workers, including surgeons, nurses, anesthesiologists, are exposed to surgical smoke[8].

The guidelines for the control of environmental infection in health institutions include three ways to minimize exposure to

[1]Extracted from the dissertation entitled "Electrocauterization of venereal warts: presence of bioaerosols in surgical smoke", presented to the Post Graduate Program in Nursing, in 2016.

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surgical smoke: mechanical smoke evacuation systems with filtration during procedures involving human papillomavirus (HPV) ablation; local suction devices; Personal Protective Equipment (PPE) such as N95 mask or N100 respirators[5].

These workers' health care are themes of the United Nations (UN) 2030 agenda for sustainable development, which addresses one of its goals, the protection of workers and the promotion of safe and secure work environments, reducing precariousness of work[9] and favouring the development of occupational diseases. Worker health has also been the subject of debate by the Association of PeriOperative Registered Nurses (AORN), which has launched a campaign on a smoke-free environment.

This way, the objective of this study was to analyze the capacity of bioaerosol retention filters with the use of a surgical vacuum cleaner in procedures for the cauterization of venereal warts.

## METHODOLOGY

Descriptive, with cross-sectional design and quantitative approach field research. Developed at the urology outpatient clinic of a reference center for sexually transmitted infections that treat patients residing in the area covered by the 17th Regional Health.

During data collection, 256 patients were treated, of whom 78 underwent cauterization of venereal warts. However, five patients refused to receive surgical smoke collection during their treatment, and one was under 18 years of age. Thus, the smoke produced by the electrocautery of 72 cauterization procedures was collected from April to July 2016. Outpatient visits occurred twice a week with prior schedules, with a mean of 16 cauterizations per week. We analyzed 24 filters coupled to two devices, used for aspiration of the surgical smoke during the procedures of cauterizations of venereal warts.

As inclusion criterion, all the consultations in which cauterizations of venereal warts were carried out in male persons, with the use of electrocautery, in the urology outpatient clinic during the period of data collection. Methods of cauterization by chemical method of warts caused by HPV, procedures performed on patients under the age of 18 years and on female subjects, were excluded.

To collect the clinical and sociodemographic information of the patients, a structured instrument was done, with the following data: cauterization date, city of origin, age, education, income, marital status, diagnosis, number of consultations of each patient and procedure time. These secondary data were collected from the records obtained in the medical records of patients submitted to electrocauterization during the period of data collection.

In the procedures for the electrocauterization of venereal warts, the equipment 1 was used to vacuum aspiration, with automatic switching, of 127 V and suction capacity of 50/60 Hz and flow rate of 26 liters/minute, with a rubber hose coupled to the equipment and maintained at five centimeters from the cauterization field. During all procedures, equipment 1 was kept connected with the electrocautery and the medical professional performed the electrocauterizations using N95 mask according to international recommendations.

This equipment with Ultra-low Particulate Air (ULPA) type filter, considered a control filter, has a retention capacity of up to 99.999% for particles of size up to 0.1 μm[7, 10], used to determine the exchange time.

Equipment 2 is a vacuum pump with technical characteristics, programmed flow and capacity identical to the performance of equipment 1. The equipment 2 was used to attach the other filters, identified as a barrier filter, used in the equipment to retain the bioaerosols, a control filter, arranged just behind the barrier filter to identify the saturation of the filter used as a barrier and in a second hose coupled to the same equipment were attached to the filters identified as the environment filter. These filters were kept in an adapter named the open face to collect the smoke released into the environment.

All filters were exchanged between 7, 15, 30, 60 and 90 days, predetermined by the researcher to identify in which period between 7 and 120 days the equipment barrier filter is no longer adequate retention of bioaerosols.

In the hose bifurcation of the equipment 2, the open face adapter was coupled with the filter to collect the smoke from the environment, a

flow regulated by a needle valve with suction capacity of 5.2 liters/minute, flow corresponding to respiratory capacity of a healthy adult[11] and the open face filter was kept at the same height as the upper respiratory tract of the medical professional who performed the procedures.

The equipment flow rate was tested and regulated weekly with the aid of a rotameter ensuring that the same flow was kept throughout the data collection period.

Six samples of the environment were collected using the open face. These filters were collected in the same period of collection of other samples and submitted to the analysis for the identification of possible bioaerosols present in the smoke generated by the electrocautery and inhaled by the professional during the procedures.

The filters were analyzed in a clinical analysis laboratory by the conventional Polymerase Chain Reaction (PCR) reading method. The method evaluates the presence or absence of viral Deoxyribonucleic Acid (DNA) in a qualitative way according to specific primers applied in each test but does not present quantitative values. For this reason, the quantitative value for the viral DNA found is not being presented.

After preparation, the samples were submitted to the PCR test using 5µl of buffer, 1.5µl MgCl2, 0.2µl Taq, 1µl of each specific primer (at a concentration of 20 pmol), 1µl of the sample. These samples were placed in thermocycler with the following schedule 94; 6'- 40x 94: 45" + 55: 45" + 72: 45". Afterwards, they were submitted to the analysis by electrophoresis, with agarose gel at 1% and after one hour and thirty minutes were stained with ethidium bromide at 0.2µg/ml for five minutes and in the water to bleach for thirty minutes. The reading was performed in a transilluminator with Ultra Violet (UV) light at the wavelength of 302nm and the samples analyzed in the Alpha image program.

Specific Invitrogen primers were used to search for Simple Herpes, Herpes Zoster, Hepatitis C, Human Immunodeficiency Virus (HIV), Hepatitis B and HPV.

The results were submitted to the Statistical Package for the Social Sciences (SPSS) version 20.0, using descriptive statistical analysis.

The research met the requirements of resolution no. 466/12 of the National Health Council. Participants were informed about the objectives of the research and the consent formalized by signing the Term of Free and Informed Consent. This study was approved by the Research Ethics Committee involving Human Subjects under CAAE 53181516.7.0000.5231 and opinion 1,421,266.

## RESULTS

Concerning the sociodemographic characterization of patients submitted to the cauterization of venereal warts, 40 (55.5%) had up to 24 years of age, 36 (50.0%) completed elementary education, 42 (58.3%) were single and 44 (61.1%) and income of up to one minimum wage.

Regarding the diagnoses of patients submitted to the electrocautery of venereal warts, 65 (90.3%) had HPV, as shown in table 1.

**Table 1-** Distribution of the diagnoses presented by patients submitted to the electrocautery of venereal warts. Paraná, Brazil, 2016. (n = 72)

| Variable | N | % |
|---|---|---|
| **Diagnostic** | | |
| HPV | 65 | 90.3 |
| HPV and Simple Herpes | 3 | 4.2 |
| HPV and HIV | 2 | 2.8 |
| HPV and Syphilis | 2 | 2.8 |

Concerning the number of consultations that the participants of this study were submitted, 54.2% were being treated for the first time in this service, and the others had already undergone more than four visits.

Regarding the number of procedures

performed during the collection of surgical smoke, from the 1st to the 15th day 18% of the procedures were performed; from the 16th to the 30th day, 9.7%; from 31st to 60th day, 19.4%; from 61st to 90th day, 31.9%; and from 91st to 120th day, 21.0%. Regarding the time of procedure of the electrocautery of venereal warts, 59.7% remained between 31 to 60 seconds, 34.7% over 60 seconds and 5.6% with permanence of up to 30 seconds.

The filter of the equipment retained 99.999% of the bioaerosols from the surgical smoke up to 15 days of use. In this period, all the bioaerosols studied were absent in the equipment control filter and in the open face, but after 30 days was observed the presence of HPV in both the equipment filter and the control as shown in table 2.

**Table 2** – Distribution of bioaerosol retention in the filters used in electrocautery smoke aspiration equipment in procedures of cauterization of venereal warts, according to the filter replacement period. Paraná, Brazil, 2016.

| Time | Open Face* | Equipment Filter | Control Filter |
|---|---|---|---|
| 7 days | Absent | HPV | Absent |
| 15 days | Absent | HPV + Hepatitis B | Absent |
| 30 days | Absent | HPV | HPV |
| 60 days | HPV | HPV | HPV |
| 90 days | HPV + Herpes | HPV + Herpes | HPV |
| 120 days | HPV + Herpes | HPV | HPV + Herpes |

* Environment filter

In the filter that remained throughout the collection period (120 days) used in equipment 1, the presence of HPV virus and Herpes Simplex virus DNA was detected, but the Hepatitis B virus DNA present in the filter of equipment 2 taken after 15 days.

## DISCUSSION

The socio-demographic characteristics found in this study are similar to the results found in a Brazilian cohort that followed 1118 men, younger than 30 years old and with a higher development of genital warts[12].

Most patients submitted to the electrocautery of venereal warts had a diagnosis of HPV. It is a Sexually Transmissible Infection (STI) of high prevalence, which can be caused by 40 different genotypes of HPV, characterized by being asymptomatic at the beginning of infection and culminating in the development of genital lesions with carcinogenic potential[13].

From the 16th day of use, viral DNA was identified in the filters, despite the low percentage of cauterization carried out in this period. This result is in line with a pilot study conducted in Germany with women who underwent squamous intraepithelial excisions of the cervix, being detected contamination with high-risk HPV in surgical smoke, even with a low number of cases. However, the infectivity capacity of these HPV particles has not been investigated[14].

This way, the presence of DNA in the filters can be influenced not only by the number of procedures performed, but by the time of effective use of the electrocautery and duration of the surgery, which together can compromise ULPA filter life and decrease its barrier capacity[7]. Thus, it is recommended that ULPA filters be used approximately 20 times or for 20 to 30 hours to ensure adequate particle collection[15].

The results of this study indicate the necessity of changing the filter of the aspirator in up to 15 days, because the filtration capacity was compromised after this period. However, it is important to observe the smoke evacuator filter replacement recommendations as advised by the manufacturer, appropriate disposal, considering it biological waste[8].

The analysis of the filters collected with 15 days shows that a patient with Hepatitis B was treated, which was not described in the medical record. However, the filter that remained throughout the collection period did not retain

the viral DNA of Hepatitis B, even though it is considered a virus that presents high viability even outside the body[16]. This result show the need of other studies that control variables, among them the viability and the amount of DNA required for its detection in the PCR tests.

DNA from Herpes Simplex virus, Hepatitis B and HPV types 6, 11 and 18 were identified in the samples studied, the first two being considered low risk for cancer development and type 18 classified as high risk for development of this disease[17]. According to the literature, these typologies of HPV found have tropism on the genital mucosa[18-19], leading to the appearance of venereal warts, a finding that is in line with the sample presented in this study.

The literature reports cases of HPV- positive squamous cell carcinoma in workers who had no identifiable risk factors for oropharyngeal or HPV cancer, except for occupational exposure to surgical smoke without adequate protection during HPV- positive procedures[4].

Despite evidence of the harmful effects of surgical smoke in recent decades, the evidence suggests that there is a lack of knowledge and awareness about the hazards associated with this risk, also the international guidelines for smoke evacuation[20].

The AORN reports in the Implementation Guideline for Surgical Smoke Safety that healthcare institutions should provide a work environment free of surgical smoke. Procedures for safety in relation to surgical smoke should be developed periodically and the perioperative team should be able to perform improvement activities to evacuate the smoke[20].

To reduce the effects of exposure to surgical smoke, in addition to the use of PPE, it is recommended to implement ventilation in the surgical rooms with air changes (20 changes per hour), work practice controls such as smoke aspirators, administrative controls with elaboration of standard procedures and permanent education of the team exposed to this risk[20].

Another relevant aspect relates to the use of appropriate PPE. It is known that health workers use surgical masks during all procedures, which provide protection as a physical barrier to the patient's body fluid spills. However, this mask does not provide adequate respiratory protection against small particles carried by the air[7], which makes the use of this mask questionable as the only Individual Protection Equipment (PPE) in the case of exposure to surgical smoke.

It is important to emphasize that in addition to evacuating smoke, those exposed should also use respiratory protection, such as the N95 mask, being second level of defense against surgical smoke[20], as used in this investigation.

As a limitation of this study we present the fact that data collection was restricted to the presence or absence of bioaerosols in the surgical smoke and not the quantification or viability of the DNA That was due to the high cost of using real-time PCR for the quantification of the viral DNA and the lack of control of the environmental variables required in experimental clinical research.

It is highlighted the importance of new studies in which the environmental variables are controlled and the use of PPE as the N95 mask associated to this aspirator is tested, so that the filter efficiency can be longer and to guarantee greater safety to the professional involved in this activity.

This study warns of the need for health care of workers who are exposed to electrocautery smoke, considering the need to acquire aspirators of surgical smoke in the health services. Likewise, it is advised that in places where the surgical smoke aspirator is a reality, there is a need for proper use, exchange and disposal of bioaerosol retention filters.

## CONCLUSION

Viral DNA of Simple Herpes, Hepatitis B and HPV were found in the smoke released during the procedures of cauterizations of venereal warts. The use of a smoke vacuum during electrocautery was able to retain these bioaerosols. In this service, it is suggested that the ULPA type filter used in the aspiration equipment be changed every 15 days so that the retention capacity of these bioaerosols is guaranteed.

## ELETROCAUTERIZAÇÃO DE VERRUGAS VENÉREAS: PRESENÇA DE BIOAEROSSÓIS NA FUMAÇA CIRÚRGICA


## RESUMO

**Objetivo:** analisar a capacidade dos filtros de retenção de bioaerossóis com o uso de aspirador de fumaça cirúrgica em procedimentos de cauterização de verrugas venéreas. **Método:** pesquisa de campo, descritiva, transversal e quantitativa. O estudo foi desenvolvido em um centro de referência para infecções sexualmente transmissíveis no Norte do estado do Paraná, no ambulatório de urologia. A coleta de dados foi realizada no período de abril a julho de 2016, com uma amostra obtida a partir de 72 procedimentos de cauterização. Realizou-se análise estatística descritiva. **Resultados:** foram analisados 24 filtros acoplados em dois equipamentos, utilizados para aspiração da fumaça. O método da Reação em Cadeia da Polimerase convencional foi utilizado para a leitura dos filtros, sendo utilizados *primers* específicos para a pesquisa de Herpes Simples, Herpes Zoster, Hepatite C, Vírus da Imunodeficiência Humana, Hepatite B e Papiloma Vírus Humano. A partir das amostras analisadas foram encontrados Ácido Desoxirribonucleico viral do Herpes Simples, Hepatite B e Papiloma Vírus Humano nos filtros analisados. **Conclusão:** O uso de um equipamento de aspiração de fumaça cirúrgica, com filtros *Ultra-low Particulate Air* , durante as cauterizações de verrugas venéreas mostrou-se capaz de reter bioaerossóis quando respeitado o tempo de troca dos filtros.


**Palavras-chave:** Eletrocirurgia. Saúde do trabalhador. Exposição ocupacional. Fatores Biológicos.

## ELECTROCAUTERIZACIÓN DE VERRUGAS VENÉREAS: PRESENCIA DE BIOAEROSOLES EN EL HUMO QUIRÚRGICO


## RESUMEN

**Objetivo:** analizar la capacidad de los filtros de retención de bioaerosoles con el uso de aspirador de humo quirúrgico en procedimientos de cauterización de verrugas venéreas. **Método:** investigación de campo, descriptiva, transversal y cuantitativa. El estudio fue desarrollado en un centro de referencia para enfermedades de transmisión sexual en el Norte del estado de Paraná-Brasil, en un centro ambulatorio de urología. La recolección de datos fue realizada en el período de abril a julio de 2016, con una muestra obtenida a partir de 72 procedimientos de cauterización. Se realizó análisis estadístico descriptivo. **Resultados:** fueron analizados 24 filtros acoplados en dos equipamientos, utilizados para aspiración del humo. El método de la Reacción en Cadena de la Polimerasa convencional fue utilizado para la lectura de los filtros, siendo utilizados *primers* específicos para la investigación de Herpes Simple, Herpes Zóster, Hepatitis C, Virus de Inmunodeficiencia Humana, Hepatitis B y Virus del Papiloma Humano. A partir de las muestras analizadas fueron encontrados Ácido Desoxirribonucleico viral de Herpes Simple, Hepatitis B y Virus del Papiloma Humano en los filtros analizados. **Conclusión:** El uso de un equipamiento de aspiración de humo quirúrgico, con filtros *Ultra-low Particulate Air*, durante las cauterizaciones de verrugas venéreas se mostró capaz de retener bioaerosoles cuando respetado el tiempo de sustitución de los filtros.


**Palabras clave:** Electrocirugía. Salud del trabajador. Exposición ocupacional. Factores Biológicos.

## REFERENCES


1. Martins JT, Bobroff MCC, Andrade AN, Menezes GD. Emergency nursing team: occupational risks and self protection. Rev enferm UERJ. [on-line] 2014 Mai/Jun [citado 2018 out 06]; 22(3): 334-40. Available from: https://www.e-publicacoes.uerj.br/index.php/enfermagemuerj/article/view/13690.

2. Stanganelli NC, Ribeiro RP, Claudio CV, Martins JT, Ribeiro PHV, Ribeiro BGA. O uso dos equipamentos de proteção individual entre os trabalhadores de enfermagem acidentados com instrumentos perfurocortantes. Cogitare Enferm. [on-line] 2015 Abr/Jun [citado 2019 jan 26]; 20(2): 343-49. doi: http://dx.doi.org/10.1590/S0034-71672000000400011.

3. Costa IKF, Costa IKF, Souza AJG, Gomes ATL, Simpson CA, Farias GM. Knowledge about work accident by the nursing in servisse mobile emergency care. Cienc Cuid Saude. [on-line] 2015 Abr/Jun [citado 2019 jan 26]; 14(2): 995-1003. doi: http://dx.doi.org/10.4025/cienccuidsaude.v14i2.22583.

4. Spruce L. Back to Basics: Protection From Surgical Smoke. AORN J. [on-line] 2018 Jul [citado em 28 nov 2018]; 108(1): 24-32. doi: https://doi.org/10.1002/aorn.12273.

5. Bree K, Barnhill S, Rundell W. The Dangers of Electrosurgical Smoke to Operating Room Personnel: A Review. Workplace Health Saf. [on-line] 2017 Nov [citado em 28 nov 2018]; 65(11): 517-526. doi: https://doi.org/10.1177/2165079917691063.

6. Tramontini CC, Galvão CM, Claudio CV, Ribeiro RP, Martins JT. Composition of the electrocautery smoke: integrative literature review. Rev Esc Enferm USP. [on-line] 2016 citado em 10 ago 2017]; 50(1): 144-53. doi: http://dx.doi.org/10.1590/S0080-623420160000100019.

7. York K, Autry M. Surgical Smoke: Putting the Pieces Together to Become Smoke-Free. AORN J. [on-line] 2018 Jun [citado em 30 out 2018]; 107(6): 692-703. doi: https://doi.org/10.1002/aorn.12149.

8. Occupational Safety and Health Administration (OSHA). Laser/electrosurgery plume. [on-line] 2015 [citado em 16 nov 2018]. Washington; U.S. Department of Labor. Occupational Safety & Health Administration. Available from: https://www.osha.gov/SLTC/etools/hospital/surgical/surgical.html.

9. United Nations. Transforming our World: The 2030 Agenda for Sustainable Development. [on-line] 2015 [citado em 18 out 2017]. Available from: https://sustainabledevelopment.un.org/content/documents/21252030%20Agenda%20for%20Sustainable%20Development%20web.pdf.

10. Bargman H. Laser generated Airborne Contaminants. J Clin Aesthet Dermatol. [on-line] 2011 Feb. [citado em 15 set 2017]; 4(2): 56-7. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3050618/.

11. West JB. Fisiologia respiratória: Princípios básicos. 9ª ed. Porto Alegre: Artmed: 2013.

12. Silva RJC, Sudenga SL, Sichero L, Baggio ML, Galan L, Cintra R, et al. HPV-related external genital lesions among men

residing in Brazil. Braz J Infect Dis. [on-line] 2017 Jul /Aug [citado em 01 nov 2019]; 21(4):376-385. doi: http://dx.doi.org/10.1016/j.bjid.2017.03.004.

13. Zardo GP, Farah FP, Mendes FG, Franco CAGS, Molina GVM, Melo GN, et al. Vacina como agente de imunização contra o HPV. Ciênc Saúde Colet. [on-line] 2014 [citado 2018 nov 10]; 19(9): 3799-808. doi: http://dx.doi.org/10.1590/1413-81232014199.01532013.

14. Neumann K, Cavalar M, Rody A, Friemert L, Beyer DA. Is surgical plume developing during routine LEEPs contaminated with high-risk HPV? A pilot series of experiments. Arch Gynecol Obstet. [on-line] 2018 [citado em 16 nov 2018]; 297(2): 421-424. doi: https://doi.org/10.1007/s00404-017-4615-2.

15. Schultz L. An analysis of surgical smoke plume components, capture, and evacuation. AORN J. [on-line] 2014 Jul [citado 2018 out 10]; 99(2): 126-8. doi: https://doi.org/10.1016/j.aorn.2013.07.020.

16. World Health Organization. Guidelines for the prevention, care and treatment of persons with chronic hepatitis B infection. Geneva: WHO [on-line] 2015 [citado 2018 out 02]. Available from: https://apps.who.int/iris/bitstream/handle/10665/154590/9789241549059_eng.pdf;jsessionid=8E73C733D1311B9278E689FF4D937EDA?sequence=1.

17. Alemany L, Saunier M, Alvarado-Cabrero I, Quirós B, Salmeron J, Shin HR, et al. Human papillomavirus DNA prevalence and type distribution in anal carcinomas worldwide. Int J Cancer. [on-line] 2015 Jan. [citado em 10 abr 2017]; 136(1): 98-107. doi: https://doi.org/10.1002/ijc.28963.

18. Yanofsky VR, Patel RV, Goldenberg G. Genital warts: a comprehensive review. J Clin Aesthet Dermatol. [on-line] 2012 Jun [citado em 10 ago 2017]; 5(6): 25-36. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3390234/.

19. Tommasino M. The human papillomavirus family and its role in carcinogenesis. Semin Cancer Biol. [on-line] 2014 Jun. [citado em 06 out 2018]; 26: 13-21. doi: https://doi.org/10.1016/j.semcancer.2013.11.002.

20. Fencl JL. Guideline Implementation: Surgical Smoke Safety. AORN J. [on-line] 2017 [citado em 06 out 2018]; 105(5): 488-497. doi: https://doi.org/10.1016/j.aorn.2017.03.006.

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