Health at Work Network

Occupational Health Position Statement: HPV Vaccination & Surgical Smoke Exposure

Conclusion: No Routine HPV Vaccination

Due to insufficient evidence and lack of national guidance, **HPV vaccination is *not currently recommended*** as a routine occupational measure for staff exposure to surgical smoke.

Primary Focus: Controls & PPE

Rigorous use of engineering controls (ventilation, smoke evacuators) and PPE remains the **primary risk mitigation** for surgical plume. Vaccination would be considered only if significant residual risk persists despite these measures, and would require formal approval.

1. Background and Purpose

This position statement addresses whether **HPV vaccination** is recommended for healthcare workers who are potentially exposed to **surgical smoke (diathermy plume)** from procedures on HPV-related lesions. The question arose after clinicians in various NHS Trusts raised concerns about inhalational exposure to HPV during laser and diathermy treatments of viral warts and dysplasia. This inquiry occurs in the context of broader UK and international debate about the risk of healthcare workers developing HPV-associated lesions, including malignancies, due to chronic exposure to surgical plume.[2,4]

Surgical smoke/plume is the aerosolized by-product generated by energy-based surgical tools, for example electrocautery and laser, when cutting or ablating tissue. It contains water vapour, cellular debris, chemicals such as benzene and formaldehyde, and potentially **infectious biological material**, including viral DNA.[1,2]

Human Papillomavirus (HPV) is a DNA virus with over 100 genotypes, including high-risk oncogenic types such as 16 and 18, known to cause anogenital warts and cancers of the cervix, oropharynx and other sites. Concern specifically arises from surgical smoke generated during treatment of HPV-infected lesions, for example laser ablation of genital warts, LEEP excisions of cervical dysplasia, and ENT papilloma removal, which may carry **HPV DNA or viral particles** capable of infecting staff present in the operating room.[2,3,5]

Rationale: The aim of this document is to review the evidence on HPV transmission via surgical smoke, compare existing internal documents on this issue, and provide a clear position for NHS OH Services. It will critically appraise current evidence and guidance, consider the hierarchy of controls in managing this occupational hazard, and conclude

with recommendations on whether HPV vaccination should be provided to staff as an additional risk control measure.

2. Evidence Review and Analysis

2.1 Biological Plausibility and Laboratory Evidence

There is strong biological plausibility that **HPV exposure can occur via surgical smoke**. A substantial body of research demonstrates that **HPV DNA is present** in plume produced from treating HPV-associated lesions. For example, high-risk HPV DNA has been detected in smoke during CO_2 laser ablation of genital warts and LEEP procedures, and the detected HPV strains in plume may match those of the patient's lesions. HPV's capsid is relatively heat resistant, meaning viral particles may remain intact and potentially infectious despite the thermal process. Animal experiments also support possible viability: smoke captured from laser treatment of virus-induced lesions has been shown to transmit papillomavirus under experimental conditions. This confirms that, under certain conditions, **surgical plume can carry infectious papillomavirus** capable of transmission.[2,3]

2.2 Clinical Evidence: Case Reports and Epidemiology

Despite the demonstrated presence of HPV in surgical smoke, actual documented cases of HPV-related disease in exposed healthcare workers are very rare. The literature reveals only a handful of case reports over decades, describing clinicians who developed HPV-related upper airway disease possibly linked to occupational plume exposure. These include a laser surgeon with laryngeal papillomatosis after treating anogenital lesions, a theatre nurse with laryngeal papillomatosis recognised as an occupational disease in Germany, and reports of gynaecological surgeons who developed HPV-positive tonsillar cancers suspected to be associated with surgical smoke exposure. However, these cases are exceedingly few, and causation is not definitive. Under-reporting is possible, but no widespread epidemic of HPV disease in such staff has been observed.2,3

Epidemiological studies on this risk are limited and have inconsistent findings. A few cross-sectional studies have examined whether healthcare workers routinely exposed to plume have higher HPV infection rates. Some data suggest a trend: for example, studies have reported transient HPV DNA detection in the nasal passages of clinicians performing frequent plume-generating procedures. Importantly, these detections appear transient and may represent contamination rather than sustained infection in most cases. Other surveys have found low prevalence of oral or nasal HPV among medical staff performing laser ablations, similar to unexposed controls. Crucially, no study has convincingly demonstrated an increased long-term incidence of HPV-related disease among staff who use appropriate precautions. The 2020 systematic review by Fox-Lewis et al. concluded that while HPV DNA can contaminate staff airways via

smoke, an increased prevalence of HPV infection or HPV-related disease in operating theatre staff has not been convincingly shown.2,3

In summary, HPV transmission via surgical smoke is biologically plausible and has occurred in isolated cases, but the absolute risk appears extremely low given the limited epidemiological evidence to date. This significant uncertainty underpins the need for careful risk management and evidence-based policy.2,4

2.3 Consensus from Reviews and Guidance

Multiple literature reviews and expert position statements have examined this topic, generally reinforcing the hazard but urging caution about vaccination:

- **HSE (UK Health & Safety Executive) 2012** – A comprehensive review confirmed surgical smoke contains hazardous substances, including viral particles, and emphasised employers' duty under COSHH to prevent or minimise exposure at source. It highlighted that effective local exhaust ventilation significantly reduces smoke levels and therefore risk. No recommendation was made regarding immunisation, with the focus instead on engineering controls.1
- **Fox-Lewis et al., 2020 (systematic review)** – This Occupational & Environmental Medicine review concluded that HPV in surgical smoke should be treated as potentially infectious and advocated a triple precaution approach: local smoke evacuation, adequate general ventilation, and full PPE, including appropriate respiratory protection, for relevant procedures. The authors explicitly stated that there was insufficient evidence to recommend HPV vaccination for operating theatre staff, assuming that proper controls, if used, should be sufficient to prevent transmission.2
- **British Association of Dermatologists (BAD) position statement, 2021** – This UK professional body addressed viral risks in surgical plume, including HPV. BAD highlighted the potential hazard, called for universal use of smoke extractors in dermatology surgery and further occupational health research, and emphasised PPE and engineering controls as existing best practice. It did not advocate staff vaccination.3
- **UKHSA Green Book immunisation guidance** – The national immunisation guidance does not list occupational exposure as an indication for HPV vaccination. The NHS HPV vaccination programme is targeted at adolescents and certain defined high-risk groups. There is no UK programme or recommendation to vaccinate healthcare workers for this purpose, reflecting the currently limited evidence.5
- **International guidance (ASCCP, USA)** – In contrast to the UK, the American Society for Colposcopy and Cervical Pathology in 2020 took a precautionary approach, recommending HPV vaccination for clinicians routinely performing smoke-generating procedures on HPV lesions. This difference reflects diverging

application of the precautionary principle: US guidance errs on the side of offering vaccination, whereas UK bodies have so far held a more conservative stance pending stronger evidence.6

- **Occupational Medicine editorial, 2023 (Shemtob et al.)** – UK occupational health experts reviewed the debate and highlighted that immunisation is considered a last line of defence under COSHH because it protects only after a pathogen has entered the body. They note that HPV vaccine efficacy against oropharyngeal infection or cancer is unproven and stress the importance of ventilation and PPE, which protect against both the chemical and infectious components of surgical smoke. They pose the central question: whether to invoke the precautionary principle and vaccinate at-risk staff despite uncertain benefit, or concentrate on strengthening environmental controls while awaiting better evidence.4

Summary of Evidence Quality: The overall evidence base is characterised by biological plausibility and precautionary concern rather than definitive proof of harm or protection by vaccination. There is no direct evidence that vaccinating healthcare workers prevents head and neck cancers or papillomatosis in this context. What is clear is that surgical smoke is an occupational hazard containing potentially harmful chemical and biological agents and therefore warrants robust risk controls under general health and safety law. The key controversy is whether adding HPV vaccination, which is safe and partially protective against certain HPV types, is justified as an additional layer of defence.1,2,4

2.4 Considerations of HPV Vaccine for Occupational Use

When evaluating **HPV vaccination as a possible control measure** for surgical smoke exposure, several factors must be weighed:

- **Vaccine Coverage:** The available **HPV vaccines (Gardasil/Gardasil 9)** cover the most common high-risk HPV strains (e.g. 16, 18, and 7 additional types in Gardasil-9) but **do not encompass all HPV genotypes**. Occupational exposures could, in theory, involve any high-risk HPV present in patients, including types not in the vaccine.5
- **Vaccine Efficacy in Adults:** HPV vaccines show highest efficacy when given before initial HPV exposure, usually in adolescence. By contrast, many healthcare workers are older and may have had prior HPV exposure; vaccine efficacy in such adults is reduced, and it offers no therapeutic benefit for existing HPV infection. Thus, immunising mid-career staff might yield less benefit than adolescent vaccination.4,5
- **Protection of Target Organs:** The vaccine's proven benefits relate mainly to prevention of anogenital HPV infections and subsequent cancers. It is not yet evidenced that vaccination prevents oropharyngeal HPV infection or cancer;

studies have suggested it may reduce oral HPV acquisition, but conclusive data on head and neck cancer prevention are lacking. Therefore, we cannot assume a vaccinated surgeon would be fully shielded from HPV-related throat lesions if exposed via smoke.4,5

- **Safety and Cost:** On the positive side, HPV vaccines have a strong safety record and adverse effects are generally limited. From a safety standpoint, offering vaccination is therefore low risk to recipients. The cost per staff member is moderate but non-trivial in aggregate if many staff were included, and currently no external funding exists for this occupational indication, meaning the Trust would bear the full cost if implemented. There would also be logistical costs of staff time, consent, and record-keeping for any programme.5,7
- **Hierarchy of Controls:** Under UK occupational health principles, **vaccination is considered an *additional protective measure*, not a primary substitute for exposure control**. It is analogous to how Hepatitis B vaccine is offered to workers handling blood — a final layer of protection where exposure cannot be fully eliminated. Similarly, HPV vaccination would not replace the need for smoke control measures, and it acts only after exposure occurs by aiming to prevent establishment of infection.1,4

In summary, while HPV vaccination could theoretically reduce the residual risk of occupational HPV infection and is recommended by one US body, the **current evidence is insufficient** to demonstrate that it significantly improves safety beyond existing measures. It offers **partial coverage and uncertain efficacy** for the relevant outcome of upper airway disease, and **no authoritative UK body currently endorses it** for this purpose.2,4,5,6

3. Risk Assessment and Control Measures

Across the UK, surgical smoke is recognised as a hazardous exposure that **must be controlled to ALARP (As Low As Reasonably Practicable)** under general health and safety duties and the principles of COSHH. The **hierarchy of controls** is applied:1

- **Elimination/Substitution:** Insofar as possible, avoid generating plume, for example by using non-ablative techniques if clinically feasible or lower power settings that generate less smoke. Complete elimination is often impractical, so focus shifts to controlling the hazard.1
- **Engineering Controls: Local Exhaust Ventilation (LEV)** or **smoke evacuator devices** are the frontline defence. These should be **used in all procedures expected to generate smoke** and positioned close to the source to capture plume effectively. LEV units should have high-efficiency filtration capable of trapping fine particles. Adequate general theatre ventilation is also important,

especially in smaller clinic procedure rooms where fixed ventilation may be limited.1,2,3

- **Administrative Controls:** Implement standard operating procedures for plume-generating procedures, limit personnel present during such procedures, and ensure equipment, including evacuators and ventilation systems, is maintained and functioning. Staff should be trained in plume hazards and the correct use of controls, with monitoring and audit used to support compliance.1,2,3
- **Personal Protective Equipment (PPE):** As a final barrier, staff should wear appropriate PPE whenever surgical smoke exposure is possible. This includes suitable respiratory protection where indicated, eye protection to guard mucous membranes, gloves and disposable gowns. Proper donning, doffing and training are essential to ensure PPE is effective and to avoid secondary contamination.2,3

Used together, these measures can substantially reduce any viable HPV exposure. When well implemented, the residual risk of HPV transmission via plume becomes very low. The 2020 systematic review by Fox-Lewis et al. specifically noted that there is no evidence that the combination of LEV, ventilation and PPE, when properly employed, is inadequate to protect staff. In other words, state-of-the-art precautions are presumed to succeed in preventing HPV transmission, although ongoing vigilance is needed, including sustained ventilation performance and compliance monitoring.2,3

Position of Vaccination in the Control Hierarchy: Immunisation is not a primary control since it does not prevent exposure but instead aims to mitigate the consequences of exposure. Under occupational health principles, employers may consider immunisation if a biological exposure risk remains after other controls. HPV differs in that exposure can be largely controlled by engineering controls and PPE, and the vaccine's effectiveness against the relevant occupational outcome is unproven. Therefore, any decision to add vaccination must be carefully justified as an extra precaution rather than an essential requirement.1,4,5

4. Governance and Ethical Considerations

From a governance standpoint, introducing a new occupational vaccination (like HPV in this context) requires careful consideration of legal, ethical, and practical factors in the NHS setting:

- **Legal Duty and Precaution vs Evidence:** Employers must comply with health and safety duties to protect employees and reduce risks to ALARP. If a hazard is recognised, such as HPV in surgical plume, there is ethically a precautionary imperative to protect staff. However, risk control should remain proportionate to the evidence. Given the lack of definitive evidence of frequent occupational disease, the ethical approach is to balance precaution with practical efficacy.

Over-reliance on an unproven intervention such as vaccination could divert focus from proven controls, whereas ignoring a plausible risk could be difficult to defend if harm occurred. The stance taken here attempts to strike that balance by maximising established controls and carefully evaluating the marginal benefit of vaccination.1,2,4

- **Alignment with National Policy:** The absence of HPV vaccination in the Green Book or UK regulatory guidance for occupational exposure means that providing the vaccine to staff would be outside standard NHS immunisation protocols. UKHSA has indicated that national vaccine stock cannot be used for this purpose, and any employer deciding HPV vaccination is necessary should fund it locally as an occupational health measure. This makes it a local policy decision rather than a national mandate. To date, there is no established UK NHS precedent for routine HPV vaccination of staff because of surgical smoke exposure.5,7
- **Funding and Commissioning:** If an NHS Trust were to proceed with offering HPV vaccine to at-risk staff, it would require internal approval and funding. There is no central commissioning route for this occupational indication, so the cost of vaccine purchase, administration, staff time, consent and record-keeping would fall locally to the Trust or Occupational Health budget. A business case would likely be needed, weighing vaccine costs against the benefit of risk reduction, which is difficult to quantify given the low incidence of documented occupational disease. Mechanisms for delivery and record management would also need to be established through normal occupational health governance.5,7
- **Governance Process:** Any proposal to introduce HPV vaccination for staff should go through the Trust's Health & Safety Committee, or equivalent governance route, for formal review and endorsement. This would ensure multidisciplinary evaluation involving Occupational Health, Infection Prevention, clinical departments and management. If approved, a specific protocol or policy would be required, detailing eligibility criteria, delivery method, consent, documentation, follow-up and monitoring. No programme should be implemented without this robust governance process, both to ensure proper use of resources and to allow oversight of outcomes.1,4,7
- **Equity and Staff Choice:** Should the Trust decide not to provide vaccination, it should communicate the rationale transparently to concerned staff, emphasising the protective measures in place. Individual staff remain free to seek HPV vaccination privately if they wish, as a personal health measure. Occupational Health can offer advice but should not provide the vaccine occupationally without a formal policy and governance approval.5,7
- **Ethical Duty of Care:** Even in the absence of proof of frequent occupational disease, the Trust has an ethical duty to monitor emerging evidence and

guidance. If future high-quality data or regulatory guidance shifts the risk-benefit balance, the position on vaccination should be revisited. Conversely, if gaps in controls are identified, for example inadequate LEV, inconsistent respiratory protection or poor compliance with plume procedures, those should be remedied promptly as part of the duty of care.1,2,3,4,5

5. Conclusions and Recommendations

Conclusions: After a thorough review, the current **Occupational Health consensus is that routine HPV vaccination is *not currently recommended* for staff potentially exposed to surgical smoke.** The decision is grounded in the following:

- **Insufficient Evidence of Occupational Disease:** While HPV in surgical smoke is a recognized hazard, there is *no convincing epidemiological evidence of a significant disease burden* in exposed NHS staff to warrant universal vaccination. Documented cases are extremely rare and precautionary measures (LEV, PPE) appear effectively protective.2,3
- **Effective Primary Controls Exist:** Robust **engineering controls and PPE** can mitigate the risk to **as low as reasonably practicable**, fulfilling legal obligations without introducing an unproven intervention. These controls also protect against the many other harmful components of surgical smoke (chemical toxins, other viruses) that vaccination would not address.1,2,3
- **Vaccine Limitations: HPV vaccination in this context has limitations** – it offers *partial coverage* of HPV types, *diminished efficacy in adults*, and its effectiveness in preventing the relevant outcomes (e.g. oropharyngeal cancers) is *unproven*. It is not endorsed by UK authorities, and implementing it without that backing could set a precedent requiring strong justification.4,5
- **National Guidance and Consistency:** There is *no UK national recommendation* or precedent for this use of the HPV vaccine. Adopting a contrary stance locally, absent new evidence, could create inconsistencies in practice, and would rely solely on local resources.5,7

Recommendations:

1. **Do Not Implement Routine Staff HPV Vaccination at Present:** The Trust will not offer HPV vaccination to staff as an occupational health program for surgical smoke exposure at this time. This stance will be maintained until or unless new evidence or national guidance emerges to support vaccination.2,4,5,7
2. **Reinforce Hazard Controls:** The primary focus must remain on strict enforcement of smoke hazard controls: ensure smoke evacuators and ventilation are available and used in all relevant procedures, and that FFP3 masks and protective eyewear are worn as standard practice. Periodic audits

should be conducted to verify compliance and efficacy of these measures, and results reviewed by the Health & Safety Committee.1,2,3

3. **Monitor Evidence and Guidance:** Occupational Health will stay abreast of emerging research and guidance from bodies including UKHSA, HSE, BAD, and relevant international agencies. If robust data show a clear benefit to vaccination or if UK policy changes, the Trust will re-evaluate its position in light of that evidence.1,2,3,4,5,6
4. **Case-by-Case Consideration:** In the interim, if a specific high-risk scenario is identified (e.g. a group of staff with exceptionally frequent, intensive exposure to HPV-laden plume despite full controls), a separate risk assessment should be undertaken. If that assessment indicates potential benefit from vaccination, a proposal can be prepared for Trust governance review. Any approved use of HPV vaccine would be on a targeted, case-by-case basis with appropriate funding and oversight, not a broad programme.1,4,7
5. **Communication to Staff:** Provide clear communication to concerned staff and departments about this decision. Emphasize that existing protective measures are effective and are being continually improved, and explain the rationale for not vaccinating, including the current lack of evidence and official support. Staff should also be informed that they may seek HPV vaccination via their GP or privately if they personally wish, but it is not an occupational requirement or provision at this time.5,7

By focusing on proven controls and evidence-based practice, the Trust ensures compliance with health and safety law and the best protection for its staff. At the same time, the Trust remains open to revisiting the question of HPV vaccination if the evidence base or regulatory landscape changes in future. This balanced approach prioritises staff health and prudent use of resources, while adhering to UK occupational health principles of risk control.1,2,4,5,7

References (Bibliography)

1. **Beswick A, Evans G. (2012)** *Evidence for exposure and harmful effects of diathermy plumes (surgical smoke) – evidence-based literature review*. Health and Safety Executive Research Report RR922.
2. **Fox-Lewis A, Allum C, Vokes D, Roberts S. (2020)** *Human papillomavirus and surgical smoke: a systematic review*. Occup Environ Med, **77**(12): 809–817.
3. **British Association of Dermatologists (BAD). (2021)** *Position Statement on the Risk of Cancer from Viral Particles in Surgical Plume*. BAD, March 2021.
4. **Shemtob L, Asanati K, Jayasekera P. (2023)** *Should healthcare workers with occupational exposure to HPV be vaccinated?* Occup Med (Lond), **73**(3): 115–116.

5. **UK Health Security Agency (UKHSA). (2023)** *Immunisation Against Infectious Disease – The "Green Book", Chapter 18a: Human Papillomavirus (HPV)* (updated June 2023).
6. **American Society for Colposcopy and Cervical Pathology (ASCCP). (2020)** *Clinical guidance statement recommending HPV vaccination for clinicians with occupational HPV exposure*. ASCCP guidance to members, July 2020.
7. **Ferris M.** Personal communication/email confirming no current basis to use national HPV vaccine stock for occupational exposure, and that any such staff vaccination programme would be a local employer responsibility.