British Journal of Hospital Medicine

Br. J. Hosp. Med. (Lond) **2026**; 87(11): 57655
https://doi.org/10.31083/BJHM57655

Editorial

Protecting Healthcare Workers From Carcinogenic Formaldehyde Exposure

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Academic Editor: Livio Garattini
Submitted: 1 September 2026 Revised: 21 October 2026 Accepted: 27 October 2026 Published: 24 November 2026

Formaldehyde exposure is a commonly known issue in workplaces globally, yet not enough is done to protect people who have to work with the substance. For many, exposure results in minor health implications, but for some, it can be fatal. No one should have to face occupational exposure to hazardous substances without the proper protections, so why is this still happening today?

In February 2026, a Danish public broadcaster aired a documentary in which four former anatomy dissection assistants at the University of Copenhagen had developed cancer before the age of 35 [1]. They worked in the same room, over roughly the same decade, and they routinely handled formalin, the liquid form of formaldehyde, used to preserve human tissue. Three of the four assistants died. The programme was careful not to assert where the cause lay, but within a cohort of forty people, those numbers demand more than careful words.

Similarly, in the United Kingdom, Channel 4 recently published an exclusive story on how regulators are failing to protect National Health Service (NHS) staff exposed to this cancer-causing chemical, formaldehyde, which they dubbed 'the new asbestos' [2], a phrase that the European Biosafety Network (EBN) does not endorse, but which demonstrates the severity of the situation.

Formalin is a formulation of formaldehyde in aqueous solution and is composed of three components: formaldehyde, methanol, and water. Formalin is an effective tissue fixative, and even after decades of research, there are no comparably effective alternatives available. It is accurate, reliable, and affordable.

Embalming bodies, preserving tissue samples, and disinfecting—formaldehyde is a ubiquitous chemical in healthcare environments. Every day in hospitals across Europe, operating theatre nurses and pathology technicians handle it as a matter of routine. The problem is that routine handling means routine exposure to a substance the International Agency for Research on Cancer classifies as a Group 1 human carcinogen [3]. Exposure, in the majority of European healthcare settings, remains poorly measured, poorly controlled and poorly understood by the institutions responsible for managing it.

A study published in 2026 in Occupational and Environmental Medicine [4], drawing on Freedom of Information disclosures from all 122 NHS Trusts across the UK, found that airborne formaldehyde concentrations exceeded European safety thresholds at 70% of monitored laboratory sites. Nearly three-quarters of those sites tested their air quality once a week or less, and 15% did so quarterly.

The UK's legal exposure limit, set at 2.0 parts per million (ppm) both for an 8-hour time-weighted average (TWA) and a 15-minute short-term exposure limit (STEL), is currently the highest permitted anywhere in the world, and yet measured against the more protective European standard of 0.3 ppm as an 8-hour TWA, with a 15-minute STEL of 0.6 ppm, the majority of NHS laboratories are failing [5,6]. This is a protection problem, and there is no reason to believe the picture across the rest of Europe is materially better.

Staff who handle formalin regularly report eye and airway irritation, headaches, allergic rhinitis, asthma and contact dermatitis at rates significantly higher than colleagues who do not [7]. A cross-sectional study of hospital workers exposed at less than a tenth of the legally permitted level found that the odds of developing allergic rhinitis were almost 17 times higher than among unexposed colleagues [8]. Staying below accepted levels is not the same as keeping people safe from exposure, and the legal threshold was never designed to be a safe dose, only an enforceable one.

Formaldehyde is toxic primarily at the point of entry: inhaled, it acts directly on the cells lining the nose and upper airways, damaging DNA and disrupting the cellular processes that ordinarily prevent cancerous change [9]. Cancers of the nasopharynx and nasal cavities are the outcomes most consistently linked to occupational exposure across the published literature [10].

Both the European Union (EU) Carcinogens, Mutagens and Reprotoxic Substances Directive (CMRD), strengthened in 2022, and equivalent national occupational health legislation across EU member states are built on the hierarchy of controls [11]. This hierarchy means that where a carcinogen cannot be eliminated or substituted, employers are required to contain it through engineering controls, which are known as 'closed systems'. Closed systems me-

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chanically prevent the risk of exposure at source. Formalin cannot yet be eliminated or substituted, so should be handled within closed systems. These systems exist today and are widely available.

Following the same hierarchy of controls, closed systems should be implemented before ventilation or personal protective equipment (PPE), which both come lower in the list of priorities. A surgical mask and nitrile gloves offer virtually no protection against a volatile gas; they are designed for biological splashes, not airborne carcinogens, and their routine use in formalin-handling tasks creates a potentially dangerous illusion of safety [12]. Ventilation systems reduce ambient concentrations but cannot suppress the spike of vapour released the moment a container is opened, the single highest-exposure event in the specimen pathway.

Of course, these protections should also be deployed to maximise safety, but many institutions today rely on these administrative controls and PPE without first considering closed systems, which is ineffective and goes against current legislation.

Closed-system specimen containers meet these regulatory requirements by encapsulating formalin and preventing vapour release during handling. Formalin is released into the chamber only after the sample is secured inside, ensuring no separate step where formalin has to be added or activated by hand. This prevents vapour release at the point of specimen collection and during routine handling.

Theatre nurses, who handle pre-filled containers at the point of specimen collection, often without access to the fume hoods available in laboratory settings, are frequently the most exposed and the least protected of all healthcare professionals. Monitoring data from pathology departments consistently records short-term exposure peaks during grossing, the manual slicing and inspection of specimens, approaching concentrations up to eight times the World Health Organization (WHO) indoor air quality guideline [13]. These are not edge cases; they are predictable consequences of a system that has never been designed around hazard mitigation.

Across hospital systems in Europe, and in the Americas and Australasia, closed-system specimen containers seal formalin within the container through the entire specimen pathway, preventing vapour release during handling, transport and storage. A twenty-year monitoring programme at Careggi University Hospital in Florence found that moving to closed systems reduced airborne formaldehyde concentrations by more than 90%, to levels that are effectively negligible whilst diagnostic quality was unaffected [14].

What has been missing is the regulatory pressure to make adoption the default rather than the exception. The EBN has been tracking this issue across member states and has consistently found the same pattern: the science is settled, the legal framework is sufficient, and the technology is available, but without clear enforcement expectations and mandated monitoring standards, institutions default to the cheapest and most familiar option, which is also the least protective. Voluntary adoption, in an environment of competing budgetary pressures, has not worked and will not work without regulation.

Occupational exposure limits across Europe should reflect what the evidence of harm shows us, not what was politically negotiable at the time limits were last reviewed [15]. Monitoring requirements should be mandatory, frequent and personal [16]. The CMRD already provides the legal basis for this; what is required is enforcement with substance.

Key Points

• Formaldehyde is classified as a Group 1 human carcinogen, yet operating theatre nurses, pathology technicians and laboratory staff are exposed to it routinely through the use of formalin to fix tissue specimens.

• Recent evidence shows that airborne formaldehyde concentrations exceeded European safety thresholds at 70% of monitored NHS laboratory sites, and adverse health effects have been reported among staff exposed well below legal limits.

• Because formalin cannot currently be eliminated or substituted, the hierarchy of controls under the CMRD and equivalent national legislation requires it to be handled in closed systems before reliance is placed on ventilation or PPE.

• Closed-system specimen containers can reduce airborne formaldehyde concentrations by more than 90% without affecting diagnostic quality, but adoption remains limited without regulatory pressure.

• Occupational exposure limits should be reviewed in line with the evidence of harm, and exposure monitoring should be made mandatory and enforced.

Availability of Data and Materials

Not applicable.

Author Contributions

JC and ASN both made contributions to the conception and design of the work and to the analysis and interpretation of the evidence; both drafted the manuscript and critically revised it for important intellectual content; both gave final approval of the version to be published; and both agreed to be accountable for all aspects of the work, ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Ethics Approval and Consent to Participate

Not applicable.

Acknowledgment

Not applicable.

Funding

This editorial was funded by BiopSafe under a commissioned services agreement with the European Biosafety Network. No grant number applies.

Conflicts of Interest

The authors' work on this topic is commissioned by BiopSafe, a supplier of closed-system specimen containers. The article does not name or endorse any commercial product. The authors declare no conflicts of interest.

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