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Commentary
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A Reflective Commentary on Occupational Radiation Exposure, Cancer Claims, and Scientific Responsibility in Hospitals: From the Perspective of an Ecotoxicologist

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Abstract

Recent concerns involving cancer cases among hospital staffs in Malaysia, particularly those working in radiation-related units, have triggered legal action and public debate. As an ecotoxicologist, this situation is not unfamiliar. It reflects a broader and recurring challenge in environmental health sciences: the difficulty of linking chronic, low-dose exposure to long-term biological outcomes. This commentary reflects on the scientific, ethical, and institutional dimensions of such cases. Drawing parallels with heavy metal ecotoxicology, this paper examines the complexity of dose-response relationships, the uncertainty of causation, and the importance of monitoring systems. It argues that beyond legal outcomes, the case highlights deeper issues of trust, transparency, and scientific responsibility in occupational health.

Keywords: Radiation Exposure; Occupational Health; Ecotoxicology; Cancer Risk; Biomonitoring

Introduction

There are moments in science when a case is no longer just a case. It becomes a reflection of how we understand risk, how we communicate uncertainty, and how we balance evidence with human experience. The recent situation involving hospital workers in Malaysia who developed cancers and are pursuing legal action over alleged occupational radiation exposure is one such moment. Public reports described allegations that several staff members working in a nuclear medicine unit developed cancers and thyroid disorders, while the hospital maintained that radiation exposure levels remained below regulatory limits and that inspections found no radiation safety violations. Subsequently, Malaysian health and radiation regulatory authorities also reported that investigations found no critical radiation safety compliance issues that could be linked to the alleged cancer cluster [1].

From a purely scientific standpoint, the central question appears simple: did radiation exposure cause these cancers? Yet, as in many ecotoxicological contexts, the answer is rarely straightforward. Radiation, like heavy metals, operates within a framework of cumulative exposure, delayed biological response, and probabilistic outcomes. The complexity lies not in whether ionizing radiation can cause harm, which is well established scientifically, but in whether it did so under specific occupational conditions. Demonstrating such causation requires careful consideration of individual radiation doses, exposure duration, latency periods, biological susceptibility, alternative risk factors, and robust epidemiological evidence rather than relying solely on the temporal occurrence of multiple disease cases within a workplace.

This commentary is written not to take sides, but to reflect on the scientific and ethical landscape surrounding such cases, grounded in ecotoxicological thinking. By examining the principles of exposure assessment, dose response relationships, uncertainty, and causal inference, this paper discusses how environmental health scientists and ecotoxicologists should approach occupational disease clusters with scientific rigor, transparency, and compassion for affected individuals while respecting the evidence generated through regulatory investigations and independent scientific inquiry.

Radiation Exposure Through an Ecotoxicological Lens

In ecotoxicology, we are trained to think in terms of exposure pathways, bioaccumulation, and

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long-term effects. These principles apply equally to ionizing radiation. Radiation interacts with biological systems primarily through DNA damage, including single- and double-strand breaks, which may lead to mutations if repair mechanisms fail [2].

Unlike acute toxicity, which produces immediate and observable effects, radiation-induced cancer is a stochastic outcome. This means that the probability of occurrence increases with dose, but there is no guaranteed threshold below which risk is absent [3].

This is conceptually similar to chronic exposure to trace metals such as cadmium or lead. In such cases, low-level exposure over time may not produce immediate symptoms, yet cumulative effects may eventually manifest as disease [4].

From this perspective, the concern raised by hospital workers is scientifically plausible. However, plausibility is not proof.

The Challenge of Causation

One of the most difficult aspects in environmental health science is establishing causation. Cancer is multifactorial. It may arise from genetic predisposition, lifestyle factors, environmental exposures, or a combination of these.

In epidemiology, a "cluster" of cancer cases must meet specific criteria before a causal link is inferred. These include statistical significance, consistent exposure pathways, and evidence of a dose-response relationship [5].

Small groups, such as a department within a hospital, are particularly prone to random variation. Apparent clusters may emerge purely by chance. This is a well-documented phenomenon and has been observed in numerous occupational and environmental settings.

As an ecotoxicologist, I have encountered similar situations in studies of metal contamination. Elevated concentrations in a few samples do not automatically indicate systemic pollution. Rigorous sampling design, replication, and statistical validation are required before conclusions can be drawn.

The same principle must apply here.

Monitoring Systems and the Question of Trust

Modern hospitals operate under strict radiation safety frameworks. These include shielding infrastructure, standard operating procedures, and personal dosimeters to monitor cumulative exposure. International guidelines recommend occupational exposure limits of 20 mSv per year averaged over five years [3].

If monitoring data show that exposure levels are within these limits, institutions often conclude that conditions are safe. Yet, this is where an important question arises: Is compliance equivalent to safety?

In ecotoxicology, measured concentrations may fall below regulatory thresholds, yet ecological or sublethal effects may still occur. Similarly, dosimeter readings represent recorded exposure, not necessarily actual exposure if devices are improperly used, misplaced, or not worn consistently.

This introduces a gap between measured reality and lived experience. For workers who develop illness, this gap becomes a source of doubt and distress.

Scientific systems rely on trust. When that trust is questioned, even compliant data may not be sufficient to reassure those affected.

Low-Dose, Long-Term Exposure: A Familiar Problem

The issue of low-dose exposure is one of the most debated topics in both radiation science and ecotoxicology. Studies of occupational radiation workers have shown slight increases in cancer risk over long periods, particularly in earlier decades when safety standards were less stringent [6]. However, at low doses typical of modern practice, the risk is small and often difficult to detect statistically.

This mirrors findings in metal toxicology. Chronic exposure to low levels of contaminants may lead to subtle physiological changes that accumulate over time. These effects are often underestimated or overlooked because they do not produce immediate or dramatic outcomes.

The difficulty lies in detection. When effects are small and delayed, large datasets and long observation periods are required to identify patterns.

In the absence of such data, uncertainty remains.

Ethical Reflection: Beyond Data

Science provides tools for measurement and analysis, but it does not fully address the human dimension of such cases. For the affected workers, the issue is not only about statistical probability. It is about health, livelihood, and trust in the system meant to protect them.

From an ethical standpoint, two responsibilities emerge:

1. To ensure that monitoring systems are accurate, transparent, and independently verifiable.

2. To acknowledge uncertainty honestly, without dismissing concerns prematurely.

In environmental science, precaution is often applied when evidence is incomplete but potential harm is significant. This principle may also be relevant in occupational settings.

Reflection as an Ecotoxicologist

When I reflect on this case, I do not see it as an isolated incident. I see a pattern that repeats across different fields of environmental health. Whether it is heavy metals in coastal waters, contaminants in sediments, or radiation in medical facilities, the core challenge remains the same, namely:

a) Exposure is often chronic and low-level,

b) Effects are delayed and probabilistic, and

c) Evidence is complex and contested

As scientists, we must resist the temptation to simplify such cases into clear-cut conclusions. At the same time, we must avoid dismissing concerns simply because they are difficult to prove. The role of science here is not only to determine causation, but also to guide responsible action under uncertainty.

Conclusion

The current situation involving cancer claims among hospital workers in Malaysia highlights the intersection of science, law, and ethics. While definitive conclusions regarding causation may

take years to establish, the case already offers important lessons. It reminds us that safety is not only a matter of compliance, but also of confidence. Monitoring systems must not only function correctly, but also be perceived as trustworthy. From an ecotoxicological perspective, the case reinforces a familiar principle: the absence of clear evidence is not the same as the absence of risk. Ultimately, the outcome of the legal process will address accountability. However, the broader scientific responsibility extends beyond the courtroom. It lies in strengthening systems, improving transparency, and ensuring that those who work within potentially hazardous environments are adequately protected, both in reality and in perception.

Declaration on the Use of Artificial Intelligence

The author declares that generative artificial intelligence tools were used in a supportive capacity during the preparation of this manuscript. These tools assisted with language refinement, structural organisation, and stylistic clarity of the text. All ideas, interpretations, reflections, and conclusions presented in this paper are the author's own and are grounded in personal experience and scholarly judgment. The author retains full responsibility for the content, accuracy, originality, and integrity of the manuscript.

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