



COMPENSATION RELATED TO THE USE OF NUCLEAR ENERGY IN THE HEALTH SECTOR IN INDONESIA

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ABSTRACT

The use of nuclear medicine plays a role in preventing and treating patients' illnesses, such as diagnosing cancer and treating cancer and cardiovascular diseases. It can also help to monitor malnutrition or obesity on its form. On the other hand, people are still worried about the use of nuclear, they always think about the impact of the Chernobyl accident and the use of nuclear energy for weapons. The International Atomic Energy Agency (IAEA) is an International organization whose main function is to encourage and assist research, development, and practical application of atomic energy for peaceful uses throughout the world. Some regulations in Indonesia and also international conventions already exist to regulate the use of nuclear energy. Indonesia has Law Number 10 of 1997 on Nuclear Energy, and some regulations on the use of nuclear energy in medicine, which also mention compensation. Internationally, the Vienna Convention on Civil Liability for Nuclear Damage and the Convention on Supplementary Compensation for Nuclear Damage (CSC). This article will discuss compensation for patient that has the damage from the use of nuclear medicine and how it can protect people from the use of nuclear techniques in medicine. According to regulations, conventions, IAEA Standards, and Indonesian regulations, in the use of nuclear techniques in the medical field, patients can receive compensation if such loss is suffered due to the fault or negligence of the healthcare facility (hospital or clinic). Compensation is not accepted for a direct consequence of the radiation about which prior information had been provided. The research method is legal normative, using regulations and other secondary data such as books and journals.

Keywords: Compensation, Health, Nuclear

A. INTRODUCTION

Nuclear technology has developed rapidly, with nuclear technology being used in various fields, including industry, health/medicine, agriculture, and energy. Internationally, the use of nuclear energy for peaceful purposes continues to be developed, even to help preserve culture and buildings. Gamma radiation was used to eradicate parasites that were destroying a wall of



precious icons in a 19th-century church in Romania. Unlike chemical or physical methods, radiation does not leave any traces on objects, nor do they become radioactive.¹

The use of nuclear energy in the health sector has been around for a long time, since the use of X-rays in hospitals to detect disease. Nuclear medicine itself is the use of radioactive materials to help diagnose or treat various diseases. Nuclear medicine involves the use of small amounts of radioactive materials (or nuclear tracers) to help diagnose and treat a variety of diseases.² Various hospitals in the world, including in Indonesia, have also used nuclear technology in the medical field, both to diagnose diseases, such as coronary heart disease, thyroid gland, and kidney function, as well as for therapy or treatment of various diseases such as cancer. As a part of their treatment, more than half of all patients with cancer today undergo radiotherapy in which high doses of ionizing radiation are aimed at killing cancer cells.³ Nuclear medicine is a medical technology that utilizes unsealed radioactive compounds to study physiological and biochemical changes, enabling their use for diagnostic, therapeutic, and medical research purposes.⁴ Furthermore, nuclear medicine uses radiation to provide information about the functioning of a person's specific organs or to treat disease. In most cases, the information is used by physicians to make a quick diagnosis of the patient's illness. The thyroid, bones, heart, liver, and many other organs can be easily imaged, and disorders in their function can be revealed.

In addition to the benefits obtained from this nuclear technique, of course, there are negative impacts from the use of nuclear medicine, such as damage to tissue around the area exposed to radiation, impaired body function due to overdose, and DNA mutations in the tissue.⁵ To overcome the use of nuclear energy in the health sector so that it does not harm humans, various international regulations have been made that regulate the use of nuclear

¹ IAEA, Elements for Success in 2020: Peacefull uses of Nuclear Energy, https://www.un.org/disarmament/wp-content/uploads/2019/12/Kamashima-Peaceful-uses-of-nuclear-energy-session_NPT_Bangkok_Dec2019.pdf. Accessed 10 April 2026.

² Stanford Medicine, Patient Care, https://med.stanford.edu/nuclearmedicine/patient_care.html. Accessed 10 April 2026.

³ Alexander Vaiserman and Alexander Koliada, "Health Impacts of Low-Dose Ionizing Radiation: Current Scientific Debates and Regulatory Issues", **Sage Journal**, September, 2018.

⁴ N.Elly Rosilawaty, I.Nasution dan Tri Wahyu Murni, "Penggunaan Radiofarmaka Untuk Diagnosa Dan Terapi Di Indonesia Dan Asas Keamanan Penggunaan Obat", **SOEPRA Jurnal Hukum Kesehatan**, Vol 3, No 1, 2017.

⁵ Jaslok Hospital, "Benefits and Risks of Nuclear Medicine Procedures", December 2025. <https://www.jaslokhospital.net/blogs/benefits-and-risks-of-nuclear-medicine-procedures>.



energy, including for health. The negative impact of nuclear or radiotherapy treatment varies. Radiotherapy uses high-energy rays to kill cancer cells, but it also affects nearby healthy tissue.

Common impacts include physical fatigue, localized skin irritation, hair loss only in the treated area, and site-specific issues like dry mouth or digestive changes. Most side effects fade after treatment ends. Compensation may be awarded to a patient if an error occurs during a procedure involving nuclear technology, such as radiotherapy. Such errors may include missed sessions due to machine breakdowns or severe side effects that allow cancer cells to multiply, or oncologists miscalculating the Biological Effective Dose (BED) to figure out how much extra radiation is needed.

Furthermore, the International Atomic Energy Agency (IAEA), as the international organization governing nuclear matters, has issued various safety series or standards to protect people from the negative impacts of nuclear use. Nevertheless, despite the existence of international nuclear regulations, public vigilance regarding the use of nuclear technology in healthcare remains high.

Therefore, it is necessary to regulate radiation doses. Radiation protection is a concept applying to all activities and facilities in which ionizing radiation is emitted by radioactive material of any origin or generated by equipment.⁶ Current standards for treatment gap calculations are performed using the Royal College of Radiologists (RCR) methodology, using a point dose for planning target volume (PTV) and the organs at risk (OAR).⁷

If a patient undergoing nuclear-based treatment suffers harm, consideration must be given to compensation for losses such as discomfort or even radiation overdose. Various regulations—both domestic and international—will be examined to assess how compensation or restitution is provided to patients who suffer harm as a result of nuclear use. As we know, Indonesia is involved in some international conventions on nuclear issues, such as the Vienna Convention on Civil Liability for Nuclear Damage and the Convention on Supplementary

⁶ Carlton Stiober, **Handbook on Nuclear Law**, Austria: IAEA, 2003.⁸

⁷ Katie O'shea, et.all, "Compensation for Radiotherapy Treatment Interruptions Due to a Cyberattack: An Isoeffective DVH-based Dose Compensation Decision Tool", *Journal of Applied Clinical Medical Physics*, July, 2022. <https://aapm.onlinelibrary.wiley.com/doi/10.1002/acm2.13716>. Accessed 15 April 2026.



Compensation for Nuclear Damage, 1998. Since the ratification of these conventions, Indonesia has an obligation to comply with the rules to protect people from nuclear damage.

The analysis was also conducted by examining regulations in Indonesia, such as Law Number 10 of 1997 concerning Nuclear Energy, Law Number 17 of 2023 Concerning Health, as well as other regulations related to compensation for nuclear damage. Nuclear Damage itself means loss of life or personal injury, and loss of property or property damage. In the health sector, personal injury can occur among both patients undergoing nuclear-based treatments and workers operating equipment that utilizes nuclear energy.

The research method used is the normative-juridical approach, which involves examining secondary data, specifically international regulations, Indonesian legislation, books, journals, and other legal materials.

B. RESULT AND DISCUSSION

This study outlines several principles and regulations that can be applied to the use of nuclear technology, particularly in the healthcare sector.

1. Principles on The Use of Nuclear Energy

Regulations are an important part of nuclear safety. Current enforcement mechanisms in nuclear safety regulation mainly refer to mechanisms maintained by the IAEA.⁸ On the other hand, the IAEA also set up the Commission on Safety Standards (“CSS”), which is a standing body of senior government officials holding domestic responsibilities for establishing standards and other regulatory documents relevant to nuclear, radiation, transport, and waste safety, and emergency preparedness and response. IAEA standards also consist of some principles that have to be applied in nuclear facilities. Several fundamental principles must be applied in the utilization of nuclear energy, namely:

- a. Safety culture is a Principle which have to be established. Safety culture governs the actions and interactions of all individuals and organizations engaged in nuclear power activities. The starting point for the necessary full attention to safety matters is with the

⁸ Miaomiao Yin, and Keyuan Zou, “The Implementation of the Precautionary Principle in Nuclear Safety Regulation: Challenges and Prospects”, *Journal Sustainability*, Vol 13, Issue 24, 2021 <https://www.mdpi.com/2071-1050/13/24/14033>. Accessed 15 April 2026.



senior management of all organizations concerned.⁹ The fundamental safety objective is to protect people and the environment from the harmful effects of ionizing radiation.

- b. Responsibility for safety: as we know, safety principles in the health sector are of utmost importance. The prime responsibility for safety must rest with the person or organization responsible for facilities and activities that give rise to radiation risks.¹⁰ One of the responsibilities of hospitals or healthcare facilities utilizing nuclear technology is to ensure that the equipment used is authorized and that the personnel operating it hold the necessary licenses. The licensee retains the primary responsibility for safety throughout the lifetime of facilities and activities, and this responsibility cannot be delegated.

- c. The principle of justification, which dictates that, for nuclear facilities and activities, it must be demonstrated that the benefits derived from the use of nuclear technology or radiation outweigh the detriments. Regarding this principle of justification, in the field of health, medical radiation exposure of patients, whether for diagnosis or treatment, is a special case, in that the benefit is primarily to the patient. For facilities and activities to be considered justified, the benefits that they yield must outweigh the radiation risks to which they give rise.

In medicine, where ionising radiation is used for diagnostic and therapeutic purposes, the requirement for justification takes a very specific form: with medical applications, a physician with expertise in the field of radiation protection has to declare the so-called "justifying indication".

- d. Optimization of protection, or the "optimization principle" in nuclear science, refers to the As Low As Reasonably Achievable principle (ALARA). It dictates that all radiation exposures must be kept as low as practicable, taking into account social and economic factors. The protection of people must be optimized to provide the highest level of safety that can reasonably be achieved. The Facilities of health must achieve this through three primary methods. Time: which means minimizing the duration of exposure, Distance: Maximizing physical distance from the radiation source. The third

⁹ IAEA, **BASIC SAFETY PRINCIPLES FOR NUCLEAR POWER PLANTS** 75-INSAG-3 Rev. 1, 1999, p.12.

¹⁰ IAEA, **Fundamental Safety Principles: IAEA SAFETY STANDARDS SERIES** No. SF-1, 2006, p 6.



is Shielding: Utilizing materials like lead, concrete, or water to block radiation. To determine whether radiation risks are as low as reasonably achievable, all such risks, whether arising from normal operations or from abnormal or accident conditions, must be assessed (using a graded approach) a priori and periodically reassessed throughout the lifetime of facilities and activities.¹¹

- e. Limitation Principles refer to the fundamental safety and operational standard where radiation doses and releases from justified nuclear activities must not exceed established regulatory thresholds.¹² However, there are no limit values for medical radiation exposure, i.e., for diagnostics or therapy. Here, the justifying indication by the specialist physician and the requirement for optimisation apply.

The risk to individuals has to be measured to control radiation risks to ensure that no individual bears an unacceptable risk of harm. Justification and optimization of protection do not in themselves guarantee that no individual bears an unacceptable risk of harm. Consequently, doses and radiation risks must be controlled within specified limits.¹³

- d. Principle of Benefit and transparency: The use of nuclear energy should provide benefits that outweigh the associated costs and risks, and the use of nuclear energy should be based on open and transparent communication of all its facets. In this regard, the impact of nuclear use must be considered to ensure that the benefits outweigh the potential harm; furthermore, transparency regarding its use is essential.

2. Compensation for Nuclear Damage

Nuclear damage can occur through its use, including in the healthcare sector. Compensation for the victim operates under a strict, exclusive liability regime where the nuclear operator is held legally and financially responsible for accidents. Compensation issues today have become more complex with the development of technology. In June

¹¹ Ibid.

¹² Principles of Radiation Protection, <https://www.nuklearesicherheit.de/en/science/physics/principles-of-radiation-protection/>, Accessed 5 May 2026.

¹³ Ibid.



2021, the United States Department of Health and Human Services reported 82 cyberattacks on healthcare sectors worldwide in the first 5 months of 2021 alone. Two examples of healthcare cyberattacks in 2021 are the ransomware cyberattacks on the Waikato District Health Board in New Zealand, which resulted in the shutdown of radiotherapy treatments for 20 days.¹⁴

a. International regulations

In the event of loss or damage resulting from the use of nuclear energy, the operator or facility owner must be held liable to the victims. Principles of nuclear liability have a Strict and Exclusive Liability: The operator of a nuclear installation is solely liable for damages. Victims do not need to prove fault or negligence; they only need to establish that the damage was caused by a nuclear incident originating at the operator's facility or transport.¹⁵

Some of the items for which compensation may be claimed in cases of nuclear damage under international and domestic regimes are:

- Loss of life or personal injury or damage to property.
- Economic loss resulting from the damage (e.g., lost business revenue in the affected zone). loss of income deriving from an economic interest in any use or enjoyment of the environment, incurred as a result of a significant impairment of that environment.
- Costs of measures of reinstatement of impaired environment (if significant).
- Costs of preventive measures (e.g., costs of evacuation).

In the Convention on Supplementary Compensation for Nuclear Damage, 1998, Article 3 mentioned about Compensation in respect of nuclear damage in all nuclear accident per nuclear incident shall be ensured by the following means:

The Installation State shall ensure the availability of 300 million SDRs or a greater amount than it may have specified to the Depositary at any time before the nuclear incident, or a transitional amount (pursuant to subparagraph (ii) This means that the country where a

¹⁴ Katie O'shea, Loc.cit

¹⁵ Nuclear Energy Agency (NEA), "Paris Convention on Third Party Liability in the Field of Nuclear Energy" https://www.oecd-nea.org/jcms/pl_20196/paris-convention-on-third-party-liability-in-the-field-of-nuclear-energy-paris-convention-or-pc. Accessed 5 May 2006.



nuclear facility is located (the Installation State) must guarantee a minimum emergency compensation fund of 300 million Special Drawing Rights (SDRs). Furthermore, Article 3 (ii) mentions that a Contracting Party may establish for a maximum of 10 years from the date of the opening for signature of this Convention, a transitional amount of at least 150 million.

Compensation for nuclear damage shall be distributed equitably without discrimination based on nationality, domicile or residence, provided that the law of the Installation State may, subject to obligations of that State under other conventions on nuclear liability, exclude nuclear damage suffered in a non-Contracting State.

The IAEA stated that Strict and Absolute Liability shall apply to the operator of a nuclear facility for personal injury, loss of life, and property/environmental damage, regardless of fault. To cover compensation payments for nuclear-related losses, the company must take out insurance. Operators and transporters of radioactive material must carry out Mandatory Insurance that is legally required to maintain sufficient financial coverage, such as specialized insurance, to meet the compensation limit.¹⁶

Nuclear damage in the health sector found that Victims claiming personal injury or loss of life are legally prioritized to ensure immediate medical costs and long-term health impacts are covered. The basis of this understanding is that radioactive exposure can result in both acute sickness and long-term health effects (such as cancers). Laws in most jurisdictions dictate that personal injury and loss of life receive priority distribution if available compensation funds are insufficient.¹⁷

International Atomic Energy Agency (IAEA), is the international organisation for nuclear energy tasked with overseeing the use of nuclear energy in all countries, including Indonesia. IAEA establishes standards issued in the IAEA Safety Standards Series. This series covers nuclear safety, radiation safety, transport safety, waste safety, and also general safety (i.e., all these areas of safety). The publication categories in the series are Safety

¹⁶ IAEA, “International Legal Framework for Civil Liability for Nuclear Damage”, Webinar Series on Nuclear Law, November 2020. <https://www.iaea.org/es/node/84132>, Accessed 10 May 2026.

¹⁷ NEA, “Priority on Compensation for Nuclear Damage in National Legislation”, https://www.oecd-nea.org/upload/docs/application/pdf/2026-02/priority_rules_2026-02.pdf, accessed 10 May 2026.



Fundamentals, Safety Requirements, and Safety Guides. International standards for radiotherapy are set by the International Atomic Energy Agency (IAEA) and also by the World Health Organization (WHO). They focus on three main rules: checking that treatment is needed, making the radiation dose as safe and precise as possible, and keeping target dose accuracy within 5%.¹⁸

One of the guidelines applicable to nuclear medicine is Safety Report Series No. 40, issued in 2005, titled “Applying Radiation Safety Standards in Nuclear Medicine”. This safety report publication explains how to ensure the safety of equipment, healthcare facilities, and operators regarding nuclear devices. The International Atomic Energy Agency (IAEA) provides global guidance on dose limits, stipulating that the dose to any member of the public should not exceed 1 millisievert (mSv) per year from all controlled sources.¹⁹

Based on the Convention on Supplementary Compensation for Nuclear Damage (CSC) and the Vienna Convention on Civil Liability for Nuclear Damage, the state or national government plays a multi-tiered role in compensating for nuclear damage to ensure victims receive adequate compensation when damages exceed the operator's private financial limits. The errors that occur during radiotherapy treatment today are wide-ranging; they stem not only from human error such as the incorrect use of equipment, but potentially also from computer hacking. For example the cyberattack on the Irish public health service in May 2021 prevented radiotherapy treatment delivery, resulting in treatment interruptions of up to 12 days.²⁰ If a patient suffers severe, permanent harm due to a provable treatment error, miscalculation, or gross negligence during radiotherapy, they may file a legal malpractice claim or a statutory no-fault medical insurance claim (where

¹⁸ Mojeed Omotayo Adelodun, et.al “Global Standards in Radiation Safety: A Comparative Analysis of Healthcare Regulations”, *International Journal of Engineering Inventions*, Volume 13, Issue 9, 2024. https://www.researchgate.net/publication/385002931_Global_Standards_in_Radiation_Safety_A_Comparative_Analysis_of_Healthcare_Regulations. Accessed 15 June 2026.

¹⁹ For radiation workers, the recommended annual dose limit is 20 mSv, averaged over five years, with no single year exceeding 50 mSv. See Adebamowo, S. N., et.al. “Genome, HLA and polygenic risk score analyses for prevalent and persistent cervical human papillomavirus (HPV) infections”. *European Journal of Human Genetics*, 32(6). 2024.

²⁰ Katie O’Shea. Loc.cit.



available) to recover damages, additional medical care, and pain and suffering. Generally, this falls under a state's national law.



b. Indonesian Regulations

In Indonesia, compensation regarding nuclear health generally splits into two categories: salaries for nuclear health professionals (such as health physicists and medical technicians) and civil liability for radiation damage.

For civil liability in the event of nuclear damage or an accident, Indonesia enforces strict limits on operator and transporter liability. The legal framework requires nuclear operators to carry financial security or insurance, with the maximum limit capped at IDR 4 trillion. The maximum cumulative compensation that can be imposed is IDR 4 trillion per occurrence (Art. 4 (2) of the Presidential Regulation No. 74 of 2012 on Nuclear Damage Liability). The nuclear installation operator is liable to third parties for nuclear damage caused by any nuclear accident occurring at any nuclear installation and/or during the transport of nuclear fuel or spent nuclear fuel for which said operator is responsible.

This provision is aligned with Government Regulation No. 46 of 2009 on Limit of Liability for Nuclear Damages, which raised the maximum monetary compensation for a nuclear accident from IDR 900 billion (stipulated under Law No. 10 of 1997) to IDR 4 trillion. Badan Pengawas tenaga Nuklir (BAPETEN) mandates licensing and financial ability to pay damages, with state facilities regulated directly by the Ministry of Finance. As previously explained, every nuclear facility must be covered by insurance. However, the Vienna Convention on Civil Liability for Nuclear Damage states that if nuclear losses with total compensation exceed the value of the operator's insurance/guarantee, or if the operator is proven unable to pay, the Indonesian Government will cover the shortfall.

According to Government Regulation No. 46 of 2009, the framework operates on strict liability, meaning the operator of the facility (such as a hospital or laboratory) is solely liable for any health damage or injuries caused by radiation without requiring proof of fault. In international conventions and Indonesian positive law, the responsibility for nuclear damage is attached to the nuclear operator.²¹

²¹ Muhamad Ichsan, "Liability for Nuclear Damage: Perspectives of International Conventions, Indonesian Positive Law, and Islamic Law", *Asy-Syir ah Jurnal*, 55 (2), Juni 2022.



The nuclear or radiological installation operator is legally required to maintain liability coverage, such as insurance or financial security, to cover nuclear damage. The liability limit is capped at Rp 4 trillion under Indonesian law. The scope of compensation coverage includes personal injury, loss of life, and loss of or damage to property. Medical or health sector damage covers radiation sickness, treatments, and any other associated health detriments sustained by workers or the general public.²² Legal protection for patients undergoing radiotherapy in the context of Law Number 17 of 2023 concerning Health. This law emphasizes the importance of a patient's right to receive clear information regarding medical procedures, including radiotherapy, as well as the associated risks and benefits.

This informed consent is an ongoing dialogue and legal process in which a radiation oncologist explains the treatment goals, simulation steps, potential side effects, and alternatives to the patient, ensuring the patient understands and voluntarily signs a written form before treatment begins.²³ Under Indonesian Health Law 2023, in the event of a loss, the provision of compensation may take the form of compensation, rehabilitation, or other forms of redress based on the agreement of the parties.

Providing compensation in forms other than monetary payment reflects the evolving paradigm of restorative justice, an approach that prioritizes repairing the harm suffered by the victim over merely exacting retribution from the perpetrator.²⁴ Through such compensation, the victim receives redress for their losses, while the healthcare professional is allowed to demonstrate good faith by taking responsibility for the consequences of their negligence. Standard compensation lawsuits require clear medical records showing the injury resulted from an avoidable mistake rather than an expected, disclosed side effect of radiation.

²² Ibid.

²³ Marie Orr and Keely Rossbotom, "Departmental practice on informed consent in radiotherapy departments: a UK evaluation", *Journal of Radiotherapy in Practice*, Vol 24, 2025, <https://www.cambridge.org/core/journals/journal-of-radiotherapy-in-practice/article/departamental-practice-on-informed-consent-in-radiotherapy-departments-a-uk-evaluation/9AB15271833390F259E92D7393EB63AB>

²⁴ A. Shientiarizki, Husada, A. M., Pamudji, K. M., Sanjaya, I. M. B., & Safarina, W. (2026). "Analisis Konsep Sengketa Medis Dan Penerapan Komunikasi Medis Yang Tepat Untuk Mencegah Terjadinya Konflik Hukum Dan Etik Di Indonesia". *Al-Zayn: Jurnal Ilmu Sosial & Hukum*, 4(3), 2856-2871. <https://doi.org/10.61104/alz.v4i3.5828>. Accessed 5 June 2026.



Certain types of medical personnel and health workers are required to hold a license to practice their profession²⁵.

This type includes medical personnel for treatment using nuclear or radiation. Medical personnel and health workers must carry out their practice within the scope of authority defined by their licenses and based on their respective competencies. Article 274 of Law number 17 of 2023 mentions that: In carrying out their duties, medical personnel and health workers are required to provide health services in accordance with professional standards, professional service standards, standard operating procedures, and professional ethics, as well as the patient's health needs.

Furthermore, they are required to obtain consent from the patient or their family for the procedures to be administered, as well as provide all information or explanation. The explanation shall at a minimum cover the healthcare procedure to be performed and its purpose; potential risks and complications; alternative procedures and their associated risks; risks if the procedure is not performed; and prognosis following the procedure²⁶. On the other hand, Article 275 mentions that patients have an obligation to provide complete and truthful information regarding their health issues and to comply with the directions or instructions of medical and health professionals.

It is prohibited to use tools, methods, or other means in providing services to the public that create the impression that the person concerned is a medical worker or health worker who has a certificate and/or licence (Article 312). There are sanctions for persons breaching Article 312: administrative sanctions and criminal sanctions. Article 439 mentions that any person who is not a Medical Professional or Health Worker but practices as a Medical Professional or Health Worker holding a Practice License (SIP) shall be punished with imprisonment for a maximum of 5 (five) years or a fine of a maximum of Rp500,000,000.00 (five hundred million rupiah).

In addition to using the appropriate equipment and dosages, the role of doctors or medical personnel includes monitoring and managing the side effects experienced by patients, thereby preserving their quality of life.

²⁵ Article 263 of *Health Law* Number 17 of 2023.

²⁶ Article 293, *Health Law* Number 17 of 2023.



Hospitals also play a role in procedures involving nuclear technology, such as radiotherapy. This includes periodically evaluating the patient's condition and providing the necessary psychological and social support throughout the treatment process. In this, Health Law also regulates the responsibility of the hospital. Article 193 mentions that the hospital is legally liable for all losses resulting from negligence committed by the hospital's healthcare personnel. Furthermore affirms that a hospital institution cannot absolve itself of responsibility for the negligent medical actions of its subordinates or affiliated healthcare professionals. This is called vicarious responsibility, which holds a hospital legally liable for the negligent acts or omissions of its doctors, nurses, or staff members committed within the scope of their employment, even if the hospital itself did not act negligently.²⁷

This responsibility applies when the negligent worker (such as an employed doctor or nurse) is a direct payroll employee acting during their normal job duties. Furthermore, the wrongful act must happen while the staff member is actively carrying out their assigned duties or providing medical care under the hospital's authority. The principle of vicarious liability, stipulated in Article 1367 of the Indonesian Civil Code (KUHP), establishes that a person is liable for unlawful acts committed by another individual under their supervision, such as a parent regarding a child, or a superior regarding a subordinate, within the scope of employment. Vicarious responsibility also involves the doctrine of corporate liability, which is an extension of the doctrine of vicarious liability. This doctrine arose because patients cannot know the status of each doctor they see.

It is hoped that this doctrine will legally hold hospitals accountable for any incidents that occur behind closed doors.²⁸ Under the doctrine of corporate liability, hospitals are required to ensure that all aspects ranging from medical facilities, infrastructure, and

²⁷ Yansen Ones Mambrasar, et.al “ Dissecting Patterns of Hospital Civil Liability in Medical Disputes: Between Vicarious Liability and Central”, *Legalis, Journal of Law Review*, Volume 2, Number 3, 2024. <https://journal.idscipub.com/index.php/legalis/article/view/323>. Accessed 5 June 2026.

²⁸ Rizal Abdurrohman, e.al, “TANGGUNG JAWAB HUKUM RUMAH SAKIT BERDASARKAN DOKTRIN CORPORATE LIABILITY MENURUT PASAL 193 UNDANG-UNDANG NOMOR 17 TAHUN 2023 TENTANG KESEHATAN”, *Jurnal Cahaya Mandalika*, Volume 3, Number 3, 2022. <https://ojs.cahayamandalika.com/index.php/jcm/article/view/3659/2863>. Accessed 8 July 2026.



equipment to the human resources working within the hospital are optimized and maintained in a state of readiness under any circumstances.

According to the World Health Organization (WHO), Hospitals hold a legal and moral duty to ensure all radiotherapy tools, like linear accelerators and computers, are safe and work properly.²⁹ They must test tools often, hire skilled workers, and follow strict rules to protect patients from harm. Hospitals hold ultimate legal and ethical responsibility to ensure a safe work environment for radiotherapy workers. This includes providing compliant radiation safety programs, personal dosimeters, routine health monitoring, proper training, and well-maintained linear accelerators or treatment machinery in line with national regulatory health standards.

In general, the legal basis for awarding compensation to patients in Indonesia is rooted in health law, the Civil Code (KUHPerduta), and regulations concerning hospitals. This right arises when it is proven that there has been an element of fault, negligence, or a violation of professional standards by medical personnel or healthcare facilities that has caused harm to the patient. Under the Civil Code, the awarding of compensation is based on two articles: Article 1365 regarding unlawful acts (tort) for individual liability (doctor or medical personnel), and Article 1367 regarding liability for the acts of others for hospitals. In addition to civil compensation, a person who causes loss to another through negligence may also be subject to criminal sanctions. An act may be categorized as criminal malpractice if it satisfies the elements of a criminal offense: the act must be blameworthy and committed with a culpable state of mind—specifically, intent, recklessness, or negligence.³⁰ Given that radiotherapy treatment entails high risks and high costs, it is typically funded through insurance. In Indonesia, patients undergoing radiotherapy can use their personal health insurance or the BPJS scheme.

The Indonesian government provides coverage for BPJS patients, including those requiring radiation or treatment using nuclear techniques. The national health insurance

²⁹ WHO, “Sustainable management of radiotherapy facilities and equipment”, October 2023, <https://www.who.int/publications/i/item/978924007506>. Accessed 10 June 2026.

³⁰ Aadilah Tsaabitah, Rospita Adelina Siregar, “Legal Certainty Regarding Compensation to Patients with a Partnership Agreement between Doctors and Hospitals”, *Journal Kolaboratif Sains*, Volume 7, Issue 3, 2024. <https://jurnal.unismuhpalu.ac.id/index.php/JKS/article/view/661/3764>. Accessed 10 June 2026.



(BPJS Kesehatan) fully covers the primary medical costs of radiation therapy. However, there is no formal government compensation system for long-term side effects. Patients often face "financial toxicity" due to out-of-pocket costs for transportation, lodging, and medicines not included in the BPJS.³¹

In addition to patients, workers or medical personnel handling nuclear treatments such as radiotherapy must also be protected from radiation exposure.

All radiation-use procedures performed by medical personnel or radiation workers have a potential risk, namely radiation exposure when carrying out their work. Protecting radiotherapy workers in a hospital involves strict adherence to safety limits, structural shielding, and core radiation safety principles (time, distance, and shielding).³² In Indonesia, a radiotherapy worker that suffering from an occupational injury or illness (such as radiation-induced health effects or loss of capacity) is covered for financial compensation and medical care through the national employment social security program managed by BPJS Ketenagakerjaan (BPJamsostek) under the Work Accident Security (Jaminan Kecelakaan Kerja - JKK) framework.³³

Workplace Accident Insurance (JKK) for medical personnel—particularly those working with radiotherapy—provides protection against the risk of accidents or occupational diseases incurred while on duty, including contracting infectious diseases at healthcare facilities or suffering radiation exposure. Consequently, oversight is essential to ensure that radiation exposure among workers (medical personnel) does not exceed permissible dose limits.

³¹ Fitria Dyah Ayu S, Et.all, "Cost analysis of radiotherapy for breast cancer in Indonesia: a comparison between reimbursement tariffs and actual costs", *BMC Health Services Research* Volume 25, article number 766 (2025). <https://link.springer.com/article/10.1186/s12913-025-12849-9#Sec1>. Accessed 10 April 2026.

³² Edy Susanto, Et.all, "Radiation Worker Protection Policy against Radiation Exposure in Carrying", *International Journal of Operations Management*, Volume 2 Issue 3, 2022. Accessed 10 June 2026. <https://researchleap.com/radiation-worker-protection-policy-against-radiation-exposure-in-carrying/>.

³³ Acclime Indonesia, "Understanding mandatory healthcare and social security BPJS in Indonesia", 2026, <https://indonesia.acclime.com/guides/mandatory-healthcare-social-security/>. Accessed 8 July 2026.



3. The Effort to Protect Human Health from Nuclear Treatment

In general, preventing nuclear damage is prioritized over paying compensation for damage that has occurred. Therefore, efforts must be made to prevent nuclear-related losses by taking measures such as :

- Training personnel or healthcare staff involved in the use of nuclear technology on patients. Several countries and international organizations offer scholarships for the training of nuclear facility operators. One of the international organisations is the World Federation of Nuclear Medicine and Biology (WFNMB). Their goals are to support education efforts for nuclear physicians, physicists, radiopharmacists, radiochemists, technologists, and other nuclear medicine scientists, especially from the developing world.³⁴
- Conducting oversight, as any country utilizing nuclear technology in the medical or healthcare sectors is required to implement supervisory measures.
- Adhere to existing regulations, particularly regarding dose limits and the use of radiation protection equipment. Including following the IAEA safety standards, especially on the health standard. Such as Safety Standards Series Number 46 on Radiation Protection and Safety on Medical Uses of Ionizing Radiation (SSG 46-2018). The IAEA have they role of ensuring adherence to proper procedures and dosage limits through international agreements or conventions, as well as other regulations such as those established by the IAEA. Bapeten, as the Indonesian regulatory body for nuclear usage in Indonesia, has established several regulations to prevent adverse health effects caused by radiation.

These include Bapeten Regulation Number 6 of 2020 concerning Radiation Safety in the Production of Radioisotopes for Radiopharmaceuticals. Among other things, it stipulates the radiation safety requirements that must be met by the license holder regarding the production of radioisotopes for radiopharmaceuticals, including defense-in-

³⁴ World Federation of Nuclear Medicine and Biology, "History WFNB" <https://www.wfnmb.org/history>. Accessed 10 Juni 2026



depth systems, proven engineering practices, records of safety verification results, and emergency response measures.

- Hospitals in Indonesia are also expected to consistently foster international collaborations with various stakeholders and participate in relevant international organizations to stay informed about developments in nuclear-based treatments. One of the new coalitions is the Global Coalition for Radiotherapy, a virtual multidisciplinary collaborative, focused on creating a world where access to quality radiotherapy is universal and equitable.

C. CONCLUSION

Nuclear technology is also beneficial for health, as certain diseases can be detected and treated using radiation. However, the treatment process inevitably entails negative impacts that result in harm to the patient. In the event of loss suffered by a patient, the nuclear facility operator shall be liable to provide compensation.

Various international regulations, as well as regulations within Indonesia, govern the payment of compensation to individuals who suffer losses due to nuclear usage—such as exposure to radiation doses exceeding established limits. One way to cover the liability for compensation payments is through insurance. However, compensation cannot be granted if the loss incurred results from the effects of a standard treatment that had been previously disclosed by medical personnel.



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