Majority Science Journal (MSJ)
P-ISSN: 0000-0000; E-ISSN: 3025-1990
Available : https://jurnalhafasy.com/index.php/msj

Vol. 4 No. 1, February 2026
DOI: https://doi.org/

EFFECTIVENESS TEST OF THE CT-SCAN ROOM AT THE RADIOLOGY DEPARTMENT OF SITI RAHMAH PADANG HOSPITAL

Cicillia Artitin[1], Riri Kurnia Putri[2], Chairun Nisa[3]
[1,2,3] Departement of Radiologi Faculty of Vokasi Universitas Baiturrahmah Padang, Indonesia

Inputed : December 12, 2025 *Revised : January 12, 2026*
Accepted : February 12, 2026 *Published : February 19, 2026*

Abstract

Radiation protection is a measure taken to reduce the harmful effects of radiation on health due to radiation exposure. The effectiveness of radiation protection in a room is an important factor in ensuring the safety of patients, healthcare workers, and the surrounding environment from unwanted radiation exposure. Field observations in the CT-Scan room are directly adjacent to other installations such as the NICU, chemodialysis, polyclinics, and patient waiting rooms. This study aims to evaluate the effectiveness of the walls, doors, and leaded glass of the CT-Scan room in blocking radiation according to national radiation safety standards. The study used an experimental quantitative method in the CT-Scan room of the Radiology Installation of RSI Siti Rahmah Padang on August 30, 2025 using a CT-Scan machine, a raysafe unforns X2 multimeter measuring instrument, a building meter measuring instrument and an air phantom. Measurement of the radiation dose rate at 12 different points, representing all components of the room structure, using exposure factors for the cranium, namely 130kv and 240 mAs. Measurements were made on the wall area leading to the surgical polyclinic, NICU room, control panel room, hemodialysis room, lead glass, and the main door, both from the inside and outside of the room. The effectiveness of radiation absorption was recorded in the range of 99.82% to 99.99%, with radiation passed less than 0.2% at all measurement points. The walls covered with 26 cm brick and 2 mm lead, as well as the doors and lead glass, were proven to meet and exceed the minimum effectiveness limit of 90% as stipulated by BAPETEN and the Indonesian Minister of Health Regulation. Thus, it can be concluded that the walls, doors, and lead glass of the CT-Scan room are effective in blocking radiation and have met radiation safety standards.
Keywords: *CT-Scan Room; Effectiveness Test,; Raysafe*

Citation :
Artitin C, Putri R, K & Nisa C., 2026. EFFECTIVENESS TEST OF THE CT-SCAN ROOM AT THE RADIOLOGY DEPARTMENT OF SITI RAHMAH PADANG HOSPITAL. *MSJ: Majority Science Journal*, Vol. 4(1), 43-47
Coresponding Author:
Author name* Cicillia Artitin
Email* cicilliaartitin@atro.unbrah.ac.id

1. Introduction

Radiology is a branch of medical science that aims to view parts of the human body using radiation or electromagnetic waves. Radiology is divided into two categories: radiodiagnostics and radiotherapy (Trikasjono et al, 2015; Artitin, 2023). X-rays are electromagnetic waves similar to radio waves, heat, light, and ultraviolet rays, but with a very short wavelength. X-rays are heterogeneous, with varying wavelengths and are invisible (Suryani, 2018; Artitin & Dewilza, 2023).

There are two types of radiation effects: deterministic effects and stochastic effects. Deterministic effects are damage to the human body exposed to radiation that will definitely occur when the radiation dose received is high. There is a clear relationship between the severity of the disease and the dose, so that a safe radiation dose can be set to avoid these deterministic effects. Examples include skin redness and cataract formation. The severity of these effects is proportional to the dose received. These effects have a threshold; if this threshold is not exceeded, there will be no effect on the body. To prevent these non-stochastic effects from occurring, a dose limit for all body tissues is required (Bapeten, 2005). Stochastic

Majority Science Journal (MSJ) Vol. 4 No. 1, February 2026
P-ISSN: 0000-0000; E-ISSN: 3025-1990
Available : https://jurnalhafasy.com/index.php/msj DOI: https://doi.org/

effects are effects that may occur. Stochastic effects can occur even within recommended radiation limits. They are associated with low-dose exposure that can manifest in humans as cancer (somatic damage) or birth defects (genetic damage) (Nugheni, 2022; Artitin, 2023; Artitin, 2018; Harahap et al., 2025).

Radiation dose is the amount of radiation present in a radiation field or the amount of radiation energy absorbed or received by the material it passes through. (BAPETEN, 2010). If radiation enters a radiation shielding material, some of the radiation will be absorbed by that material. The thicker the lead layer in a radiation room, the more effective it is at absorbing radiation. (Martem1, 2021; Fitriana, 2021).

Radiation protection is an action taken to reduce the harmful effects of radiation exposure on health. (BAPETEN, 2013). Occupational safety and health are essential measures to prevent accidents in the workplace. These measures also contribute to creating a safe, comfortable, and healthy work environment, as well as reducing or minimising the number of accidents and illnesses that occur as a result of work (Rojaya R, 2024).

According to Ministry of Health Regulation No. 24 of 2020, the wall requirements for CT scan rooms are 25 cm thick red brick or concrete with a density of 2.2 g/cm3 and a thickness of 20 cm, or the equivalent of 2 mm of lead (Pb), and the CT scan room door -Scan room must be coated with lead of a certain thickness; the material for the walls. The regulation also specifies the size of the CT Scan room, which must be at least 6 metres long, 4 metres wide and 3 metres high.

Based on observations at RSI SITI RAHMAH Padang, the CT-Scan room is adjacent to other examination rooms, such as the haemodialysis room on the right, the surgical ward on the left, the paediatric ward or NICU at the back, and the control panel room at the front. The CT-Scan examination room installed in the Radiology Department of RSI SITI RAHMAH Padang has dimensions of 6.8m in length, 5m in width, 4m in height, a door thickness of 4cm, and is lined with 2mm lead, with a wall thickness of 26cm. This is in accordance with Article 11 of BAPETEN Regulation No. 1/2011. The CT-Scan room at RSI SITI RAHMAH Padang was last tested in 2024, but the effectiveness of the room walls has never been tested at all, and there are cracks in the door to the room. This study aims to determine how effective the walls, doors, and lead glass in the CT Scan room of the Radiology Department at RSI Siti Rahmah Padang in 2025 are in blocking radiation.

2. Research Method

The type of research conducted was quantitative experimental study through field observation and literature study. The research was conducted at RSI Siti Rahmah Padang, specifically in the CT-Scan Room on 30 August 2025. The tools and materials used were a CT-Scan machine, a Raysafe Unfors X2 radiation measuring device, a building measuring device, and an air phantom. Radiation dose measurements were taken at 12 different points, representing all components of the room structure, using exposure factors for the cranium of 130kv and 240 mAs. Measurements were taken in the wall area leading to the operating theatre, the NICU room, the control panel room, the haemodialysis room, the lead glass, and the main door, both from the inside and outside of the room. The measurement results were processed using the effectiveness formula and presented in tabular form. The data obtained was then calculated using.

Formula :

Effectiveness

$$= \frac{D_0 - D}{D_0} \text{ X } 100\%$$

Explanation:

D_0 = Radiation dose rate before passing through the shielding

D = Radiation dose rate after passing through the shielding

D = Radiation dose rate after passing through the shielding

P-ISSN: 0000-0000; E-ISSN: 3025-1990
Available : https://jurnalhafasy.com/index.php/msj DOI: https://doi.org/

The data was then presented in tabular form. Conclusions and recommendations were subsequently drawn.

3. Result

Radiation Measurement Result

Table 1 Results of Radiation Exposure Test Calculations at the Radiology Installation of RSI Siti Rahmah Padang

Number	Measurement Area	Test Result
1	Area 1	0,1
2	Area 2	8,772
3	Area 3	0,1
4	Area 4	15.52
5	Area 5	2,218
6	Area 6	0,1
7	Area 7	0,5842
8	Area 8	0,1
9	Area 9	4,910
10	Area 10	0,1
11	Area 11	4,195
12	Area 12	0,1

Table 2 Results of Absorbed Dose Measurements on Each Wall of the Radiology Room at the Siti Rahmah Hospital Radiology Facility in Padang

Code	**Installation area *Unfors Raysafe X2***	**D0 (mSv/h)**	**D (mSv/h)**
1	Wall facing the surgical ward	8.772	0,0001
2	Wall facing the NICU room	15.52	0,0001
3	Wall facing the control panel	2.218	0,0001
4	Wall facing the haemodialysis room	0,584	0,0001
5	PB Glass	4,910	0,0001
6	Main door to the CT scan room	4.195	0,0001

Table 3 Hasil Pengukuran Efektifitas Penahan Radiasi Dinding di Ruang Instalasi Radiologi RSI Siti Rahmah Padang,

Kode	**Installation area *Unfors Raysafe X2***	**D0 (mSv/h)**	**D (mSv/h)**	**Efektifitas (%)**	**Kondisi**
1,2	Wall facing the surgical ward	8,770	-0,001	99,99%	effective
3,4	Wall facing the NICU room	15,50	-0,001	99,99%	effective
5,6	Wall facing the control panel	2,216	-0,001	99,95%	effective

P-ISSN: 0000-0000; E-ISSN: 3025-1990
Available : https://jurnalhafasy.com/index.php/msj DOI: https://doi.org/

7,8	Wall facing the haemodialysis room	0,582	-0,001	99,82%	effective
9,10	PB Glass	4,908	-0,001	99,97%	effective
11,12	Main door to the CT scan room	4,193	-0,001	99,99%	effective

4. Discussion

Based on Table 1, the characteristics based on age show that the largest number of respondents were aged 22 years old, with a total of 29 people (58.0%), while the smallest number were aged 21 years old, with a total of 21 people (2%). In studies conducted on populations with a relatively similar age range, namely university students or young adults, it is natural that there is a dominance of a certain age, namely 22 years old. In addition, the distribution of the population at the research site also had an influence, as the number of students or respondents aged 22 was indeed higher than other age groups. This is supported by (Notoadmodjo, 2005), who states that age can influence a person's level of maturity in thinking. The older a person is, the more mature and capable they are in their thinking and work (Huclok, 1998).

Based on Table 4.2, it is known that of the 50 respondents studied, the majority were female, with 29 respondents (58.0%). Meanwhile, there were 21 male respondents (42.0%). In line with research (Rosalina Nainggolan et al., 2024), the quality of life of women tends to be higher than that of men. This indicates that there are differences in aspects of life in relation to the quality of life of men and women. In general, the welfare of men and women is not much different, but women are more associated with positive relationship aspects, while high welfare in men is more related to better education and employment aspects. This study is also in line with research (Priliana et al., 2018) that found men are 1.3 times more likely to have a lower quality of life than women. This is because women are more emotionally mature and more resilient when facing pressure/problems. In this study, the characteristics of the population studied did indeed have more women than men, so the composition of respondents in this study also tended to be dominated by women.

Frequency Distribution of Knowledge Levels

Radiation dose measurements in conventional rooms at RSI Siti Rahmah Padang are influenced by several factors, one of which is the distance and thickness of the radiation shield. The further the distance between the radiation source and the measurement point, the smaller the radiation dose, and the closer the distance between the radiation source and the measurement point, the greater the measured radiation dose. As for radiation shielding, the thicker the radiation shield used, the greater the absorbed dose, and conversely, the thinner the radiation shield, the smaller the absorbed dose.

The effectiveness of wall absorption is influenced by several factors, namely the thickness of the shielding wall and the type of shielding material. RSI Siti Rahmah Padang uses 26 cm bricks and 2 mm black tin (Pb), where Pb is commonly used in radiology building construction as a radiation shield that can absorb the radiation dose rate from the X-ray process. This is in accordance with the regulation: Ministry of Health No. 1014 of 2008.

Research on the effectiveness of CT-Scan room construction at RSI Siti Rahmah Padang, using the Unfors Raysafe Xi device and attaching the device at 12 points, namely points 1 and 2 or the walls on the left side of the CT scan room, which are the walls facing the surgical ward, points 3 and 4 facing the NICU room, points 5 and 6 on the back wall facing the control panel, points 7 and 8 on the wall facing the haemodialysis room, points 9 and 10 on the PB glass, and points 11 and 12 on the main door of the CT-Scan room. The Unfors Raysafe Xi device was exposed once at each point and attached to both the outside and inside of the room. The data obtained from each point is reduced by the background, resulting in an effective outcome.

According to Akhadi (2000), a radiation source room must be constructed in accordance with CT-Scan room construction standards, namely having walls that are effective as radiation shields made of lead (Pb) and concrete, which can weaken radiation intensity in order to minimise the dangers or effects of radiation. The results of the effectiveness analysis at each measurement point are shown in Table 2.

Point 2 or the wall facing the operating theatre achieved 99.99% effectiveness with a distance of 170 cm from the exposure point to point 1. This means that Point 2 or the left wall inside the CT scan room is effective as a radiation shield because it can absorb more than 90% of radiation, as Point 2 or the left wall inside the CT scan room complies with Ministry of Health Regulation No. 1014 of 2008, which stipulates a thickness of 2 mm of lead (Pb). Point 4 or the wall facing the NICU room achieved an effectiveness of 99.99% with a distance from the exposure point to point 4 or the door facing the CR room of 220 cm, while at point 5 or the wall facing the control panel room, an effectiveness of 99.95% was achieved with a distance from the exposure point to point 5 or the large door of 245 cm. Point 7 or the wall facing the haemodialysis room achieved an effectiveness of 99.97% with a distance of 4.95 cm from the exposure point. Point 9 or the PB glass inside the room achieved an effectiveness of 99.97% with a distance of 343 cm from the exposure point. Point 11, or the door inside the room, achieved an effectiveness of 99.99% with a distance of 400 cm from the exposure point. Therefore, it can be concluded that point 2, or the wall facing the large surgical ward, absorbs radiation due to its proximity to the radiation source, which is 170 cm away.

The effectiveness of radiation shielding walls in CT scan rooms in absorbing radiation ranges from 99.82% to 99.99%. Tests on the effectiveness of CT scan room structures against radiation dose rates yielded the following results: point 2 or the wall facing the surgical ward was 99.99% effective, point 4 or the door facing the NICU was 99.99% effective, point 5 or the wall facing the control panel room at 99.95%, point 7 or the wall facing the modelling room at 99.82%, point 9 or PB glass at 99.97% and point 11 or the CT scan room door at 99.99%.

Based on these results, the CT-Scan room structure is effective as a radiation shield because, according to (Indrati et al., 2017), a wall is considered effective as a radiation shield if it can weaken the radiation intensity after passing through the radiation shield to 1/10 of the original intensity, i.e., its effectiveness is more than 90%...

5. Conclusions and Suggestions

Based on the results of extensive research on radiation transmitted through the walls of the CT Scan Room at the Radiology Department of RSI Siti Rahmah Padang using the Unfors RaySafe Xi measuring device, it can be concluded that the effectiveness of the radiation-shielding walls in absorbing radiation ranges from 99.82% to 99.99%. The amount of radiation transmitted through the walls, doors, and radiation-shielding glass is extremely low, measuring less than 0.2%. These findings indicate that the structural radiation protection system of the CT Scan examination room building at RSI Siti Rahmah Padang functions optimally. Furthermore, all radiation protection elements in the room have been proven to be highly effective in blocking radiation exposure and comply with established radiation safety standards in accordance with BAPETEN and the Indonesian Ministry of Health regulations, which set a minimum effectiveness threshold of 90%.

Bibliography

Akhadi, M. (2000). Pengantar Proteksi Radiasi. Jakarta: BATAN.

Artitin, Cicillia. (2023). Biologi Radiasi. Deepublish https://books.google.co.id/books/about/Biologi_Radiasi.html?id=gww-EQAAQBAJ&redir_esc=y

Artitin, C., Dewilza, N., Yudha, S., & Fahmi, D. M. (2023). Gambaran Noise Pada Pemeriksaan CT-Scan Brain Menggunakan Protokol Fast Stroke. Jurnal Kesehatan Tambusai, 4(4), 6547–6549. https://pdfs.semanticscholar.org/01d9/b83b7a4e321e8818f9d591f7904aae337d0d.pdf

Artitin, C., Harahap, W. A., & Ellyanti, A. (2018). Pengukuran Dosis Radiasi Pada Organ Tiroid dan Mata Saat Pemeriksaan Fluroskopi. Jurnal Kesehatan Andalas, 8(2), 112–118. https://doi.org/10.25077/jka.v7i0.943

Badan Pengawas Tenaga Nuklir. (2005). Peraturan Kepala BAPETEN No. 1 Tahun 2005 tentang Keselamatan Radiasi. Jakarta: BAPETEN.

Badan Pengawas Tenaga Nuklir. (2010). Panduan Dosis Radiasi. Jakarta: BAPETEN.

Badan Pengawas Tenaga Nuklir. (2013). Peraturan Kepala BAPETEN No. 1 Tahun 2013 tentang Proteksi Radiasi dan Keselamatan Radiasi. Jakarta: BAPETEN.

Diky Triwahyuni. (2021). Interaksi Sinar-X dengan Materi. Jurnal Radiologi Medik, 3(1), 15–20.

Djatmiko, B. (2016). Keselamatan dan Kesehatan Kerja di Bidang Radiologi. Jakarta: Salemba Medika.

Ernawidiati. (2017). Pengertian Radiasi Pengion. Jurnal Kesehatan, 12(2), 89–94.

Fitriana, L., & Utami, H.S. (2021). Perbedaan Nilai Image Noise dan Dosis Radiasi dengan Menggunakan Automatic Exposure Control (AEC) pada Pemeriksaan CT-Scan. Jurnal Kesehatan, 12(2). 131-136. http://dx.doi.org/10.38165/jk.

Harahap, V., Saragih, J., & Ginting, E. B. (2025). Implementation of Radiation Protection Quality Control in Radiology Installations in Accordance with Ministry of Health Regulation No. 8 Of 2011. Metadata Journal, 5(3). https://doi.org/10.47652/metadata.v5i3.843

Joedoatmodjo, S. (1994). Dasar-dasar Fisika Radiasi. Jakarta: UI Press.

Kemenkes RI. (2020). Permenkes No. 24 Tahun 2020 tentang Persyaratan Bangunan dan Sarana Rumah Sakit. Jakarta: Kementerian Kesehatan Republik Indonesia.

Kusnita. (2021). Efek Produksi Pasangan dalam Radiologi. Jurnal Fisika Medis, 2(2), 45–50.

Martem, D. R. (2021). Efektivitas Shielding Radiasi pada Ruang Radiologi. Jurnal Proteksi Radiasi, 5(2), 45–52.

Notoatmodjo, S. (2012). Metodologi Penelitian Kesehatan. Jakarta: Rineka Cipta.

Nugheni, R. (2022). Efek Stokastik dan Deterministik Radiasi. Jurnal Radiologi Indonesia, 7(1), 32–38.

Peraturan Pemerintah RI. (2008). PP No. 29 Tahun 2008 tentang Perizinan Pemanfaatan Sumber Radiasi dan Bahan Nuklir. Jakarta: Sekretariat Negara.

Rahman, A. (2009). Fisika Radiologi. Bandung: Penerbit Medika.

Rojaya, R. (2024). Kesehatan dan Keselamatan Kerja di Instalasi Radiologi. Jurnal Keselamatan Kerja, 6(1), 11–19.

Septiyanti, E., dkk. (2020). Dasar-dasar Radiologi. Yogyakarta: Graha Ilmu.