

ANALYSIS OF POLICY IMPLEMENTATION OF C-ARM FLUOROSCOPY PROCEDURE A

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ABSTRACT

The implementation of C-Arm Fluoroscopy procedures in hospitals plays a crucial role in supporting intraoperative imaging and improving clinical outcomes. However, gaps between policy, standard operating procedures (SOP), and actual practice may affect service quality and radiation safety. In RSUD Jend. A. Yani Metro, issues such as limited radiographer availability, inconsistent SOP adherence, and suboptimal radiation protection practices have been identified. To analyze the implementation of policy in the execution of C-Arm Fluoroscopy procedures at RSUD Jend. A. Yani Metro in 2026. This qualitative study used in-depth interviews, observation, and document review. Informants included radiographers, managers, doctors, and radiation protection officers. Data were analyzed using the Edward III model (communication, resources, disposition, and bureaucratic structure). Policy implementation was not optimal. SOP communication was limited, radiographer shortages led to non-compliant practices, and supervision was weak. Compliance and commitment to radiation safety varied among staff. Implementation remains suboptimal due to gaps in communication, resources, compliance, and supervision. Strengthening SOP dissemination, human resources, and monitoring is needed.

Keywords: policy implementation, C-Arm Fluoroscopy, radiology, radiographer, radiation safety

INTRODUCTION

The advancement of medical imaging technology has significantly contributed to improving the accuracy and effectiveness of diagnostic and therapeutic procedures in modern healthcare. One of the widely utilized technologies is C-Arm Fluoroscopy, which enables real-time X-ray imaging to guide intraoperative and interventional procedures. This modality plays a crucial role in enhancing clinical precision and reducing procedural risks. However, the use of fluoroscopy also exposes patients and healthcare workers to ionizing radiation, which may lead to harmful biological effects if not properly controlled. Ionizing radiation in medical imaging remains a significant source of man-made radiation exposure, requiring strict safety management and adherence to radiation protection principles (Razooqi et al., 2024).

To ensure safety, international standards emphasize the implementation of radiation protection principles, including justification, optimization, and dose limitation. Recent studies highlight that effective radiation dose management and quality assurance systems are essential in minimizing unnecessary exposure and improving patient safety in radiology services (Sekkat et al., 2025). In addition, the role of competent healthcare professionals, particularly radiographers, is fundamental in maintaining imaging quality and ensuring compliance with radiation safety protocols. Radiographers are responsible not only for operating imaging equipment but also for applying radiation protection measures and ensuring adherence to clinical standards.

In Indonesia, radiology services are regulated through national policies such as the Ministry of Health Regulation No. 24 of 2020 concerning Clinical Radiology Services, which mandates that radiological procedures must be performed by qualified personnel and supported by adequate infrastructure. Despite these regulations, challenges in implementation persist, particularly related to human resource limitations and uneven workforce distribution. Recent evidence indicates that Indonesia still faces shortages and uneven distribution of radiology professionals, which affects service coverage and workload distribution across healthcare facilities (Yunus, 2024) . Similarly, global studies have reported a growing shortage of radiographers, emphasizing the need for improved training systems and workforce development to meet increasing service demands (Susiku et al., 2024) .

At the healthcare facility level, the increasing demand for radiology-supported procedures, particularly those involving C-Arm Fluoroscopy, requires effective policy implementation to ensure service quality and patient safety. RSUD Jend. A. Yani Metro, as a referral hospital, utilizes C-Arm Fluoroscopy in various clinical units, including operating rooms, catheterization laboratories, and ESWL services. However, preliminary observations indicate that the implementation of policies related to C-Arm Fluoroscopy procedures may not yet be optimal. Issues such as limited availability of radiographers, inconsistent adherence to standard operating procedures (SOP), and suboptimal radiation protection practices have been identified as potential barriers to effective service delivery.

From a policy perspective, the success of implementation depends not only on the existence of regulations but also on how well these policies are executed in practice. The policy implementation model proposed by Edward III identifies four key factors influencing implementation effectiveness: communication, resources, disposition, and bureaucratic structure. Weaknesses in communication may result in unclear understanding of SOP, while limited resources—particularly human resources—can hinder compliance with established standards. Additionally, the attitudes and commitment of implementers, as well as the effectiveness of organizational structures and supervision mechanisms, play critical roles in determining the success of policy implementation.

Based on these considerations, it is important to conduct a comprehensive analysis of the implementation of policies related to C-Arm Fluoroscopy procedures at RSUD Jend. A. Yani Metro. This study aims to identify the factors influencing policy implementation, examine the gaps between policy and practice, and provide evidence-based recommendations to improve compliance, enhance radiation safety, and strengthen the quality of radiology services. The findings are expected to contribute to the development of more effective health policy implementation strategies, particularly in radiology services within hospital settings.

METHODS

This study employed a qualitative descriptive design to analyze the implementation of policy in the execution of C-Arm Fluoroscopy procedures at RSUD Jend. A. Yani Metro in 2026. A qualitative approach was selected to obtain an in-depth understanding of the implementation process, as well as the gaps between policy, standard operating procedures (SOP), and actual practices in the field.

The study was conducted at RSUD Jend. A. Yani Metro, a regional referral hospital in Lampung Province, Indonesia. The research was carried out from January to March 2026 in the Radiology

Installation and related units, including the operating room, catheterization laboratory (cathlab), and ESWL unit, where C-Arm Fluoroscopy is routinely utilized.

The informants were selected using a purposive sampling technique based on their roles, knowledge, and involvement in the implementation of C-Arm Fluoroscopy procedures. The participants included the head of the radiology unit, radiographers, the head of medical services, specialist doctors involved in procedures, and radiation protection officers. These informants were chosen to provide comprehensive perspectives on policy implementation from managerial, technical, and clinical viewpoints.

The focus of this study included four main variables based on the Edward III policy implementation model: communication, resources, disposition, and bureaucratic structure. The dependent aspect was the implementation of C-Arm Fluoroscopy procedures, particularly in terms of compliance with SOP, radiation protection practices, and service quality.

Data were collected through in-depth interviews, direct observations, and document review. In-depth interviews were conducted using semi-structured interview guides to explore informants' experiences and perspectives. Observations were carried out to assess the actual implementation of procedures and compliance with SOP in clinical settings. Document review included analysis of SOP, internal policies, staff schedules, and other relevant records.

Data analysis was performed using qualitative data analysis techniques, including data reduction, data display, and conclusion drawing. The data were coded and categorized based on the four variables of the Edward III model. To ensure data validity and credibility, triangulation was applied through multiple data sources (informants), methods (interviews, observations, documentation), and time of data collection.

Ethical considerations were addressed by obtaining ethical clearance prior to the study, ensuring informed consent from all participants, maintaining confidentiality and anonymity of informants, and securing permission from the hospital management before data collection.

RESULTS AND DISCUSSION

The findings of this study are presented based on the four components of the Edward III policy implementation model: communication, resources, disposition, and bureaucratic structure, as well as the overall implementation of C-Arm Fluoroscopy procedures at RSUD Jend. A. Yani Metro. In terms of communication, the results showed that although standard operating procedures (SOP) for C-Arm Fluoroscopy were available, their dissemination was not optimal. Some radiographers understood the SOP clearly; however, several non-radiology personnel involved in procedures had limited understanding of their roles and boundaries. Socialization of SOP was not conducted regularly and lacked proper documentation. Coordination among healthcare workers during procedures was generally effective, but it was mostly informal and not supported by structured communication mechanisms.

Regarding resources, the study found that the availability of human resources, particularly radiographers, was limited. This shortage led to situations where procedures were sometimes performed without the presence of a radiographer, or where non-radiology personnel operated the

equipment, which is not in accordance with regulations. In terms of competence, radiographers were generally qualified; however, training programs related to C-Arm Fluoroscopy and radiation safety were not conducted regularly. On the other hand, the availability of equipment and facilities, including the C-Arm Fluoroscopy unit, was adequate and functioned properly to support clinical services.

From the disposition aspect, the attitudes and commitment of healthcare workers toward SOP and radiation safety varied. Some staff demonstrated good compliance and awareness of safety protocols, while others showed low adherence, particularly in the consistent use of personal protective equipment (PPE) and application of radiation protection principles. This indicates that the safety culture within the organization has not been fully established.

In terms of bureaucratic structure, SOPs and organizational structures were formally available within the hospital. However, the implementation was not fully supported by effective supervision and monitoring systems. There was no routine audit or evaluation of SOP compliance, and the division of tasks among healthcare personnel was sometimes unclear, leading to overlapping roles and responsibilities. Overall, the implementation of C-Arm Fluoroscopy procedures at RSUD Jend. A. Yani Metro was found to be not yet optimal. Although services were carried out and supported by adequate equipment, there were several deviations from established SOP, particularly related to human resources, compliance, and supervision. Radiation protection practices were also not consistently applied, which may increase the risk to both patients and healthcare workers. These findings indicate the need for improvements in policy implementation to ensure safe, standardized, and high-quality radiology services.

The findings of this study indicate that the implementation of C-Arm Fluoroscopy procedures at RSUD Jend. A. Yani Metro has not yet been optimal across the dimensions of communication, resources, disposition, and bureaucratic structure. These findings are consistent with the policy implementation framework proposed by Edwards III, which emphasizes that the effectiveness of policy implementation is influenced by communication clarity, availability of resources, implementer attitudes, and organizational structure (Edwards, 1980; Mazmanian & Sabatier, 1989). Weaknesses in any of these dimensions may lead to gaps between policy and actual practice in healthcare settings (Hill & Hupe, 2021).

In the communication aspect, the study found that although SOPs were available, their dissemination was not consistent and lacked formal documentation. This resulted in varying levels of understanding among healthcare workers, particularly among non-radiology personnel. Similar findings have been reported in previous studies, where inadequate communication and lack of structured policy socialization contributed to inconsistent implementation and reduced compliance with clinical guidelines (Rahman et al., 2022; Putri et al., 2023; Widodo, 2021). Effective communication is a critical determinant of successful policy implementation, as it ensures that all implementers clearly understand their roles, responsibilities, and the objectives of the policy (Hill & Hupe, 2021; WHO, 2021).

From the resource perspective, this study identified a shortage of radiographers, which led to deviations from regulations, including the operation of C-Arm Fluoroscopy by non-qualified personnel. This finding is consistent with global and national evidence indicating that shortages

and maldistribution of radiology professionals remain significant challenges in healthcare systems (Susiku et al., 2024; Yunus, 2024; OECD, 2023). Limited human resources can increase workload, reduce adherence to SOP, and negatively impact patient safety and service quality (Alshamrani et al., 2021; IAEA, 2021). In addition, the lack of regular training programs found in this study aligns with previous research highlighting that continuous professional development is essential to maintain competency and ensure compliance with evolving radiology standards (European Commission, 2021; WHO, 2022).

The disposition aspect revealed variability in staff attitudes, commitment, and compliance with SOP and radiation protection practices. While some healthcare workers demonstrated high awareness and adherence, others showed inconsistent behavior, particularly in the use of personal protective equipment (PPE). This finding is supported by several studies indicating that individual attitudes, motivation, and organizational culture significantly influence compliance with safety protocols in healthcare settings (Khasawneh et al., 2022; Alotaibi et al., 2022; WHO, 2021). A weak safety culture can lead to negligence and increase the risk of occupational radiation exposure, emphasizing the importance of strengthening behavioral and cultural aspects within healthcare organizations (IAEA, 2021; Vano et al., 2021).

In terms of bureaucratic structure, although SOPs and organizational frameworks were formally available, the study found that supervision and monitoring mechanisms were not functioning effectively. The absence of routine audits, unclear task distribution, and overlapping roles contributed to inconsistencies in implementation. These findings are consistent with previous research showing that weak governance, lack of accountability, and ineffective supervision can hinder policy implementation and reduce compliance with established standards (Nugroho, 2020; Putri et al., 2023; OECD, 2023). A well-defined organizational structure, supported by strong leadership and regular evaluation, is essential to ensure effective implementation of healthcare policies (Hill & Hupe, 2021).

Furthermore, the findings related to suboptimal radiation protection practices are in line with global concerns regarding radiation safety in fluoroscopy procedures. Studies have shown that inadequate use of protective equipment, lack of monitoring, and poor adherence to safety protocols can significantly increase the risk of radiation exposure among healthcare workers (IAEA, 2021; Vano et al., 2021; Rehani et al., 2020). The consistent application of radiation protection principles, particularly the ALARA principle, is essential to minimize unnecessary exposure and ensure patient and staff safety (WHO, 2022; European Commission, 2021).

Overall, this study confirms that the gap between policy and practice remains a critical issue in the implementation of C-Arm Fluoroscopy procedures. Similar findings have been reported in various healthcare settings, where the existence of policies and SOPs alone is insufficient without effective implementation strategies, adequate resources, and continuous monitoring (WHO, 2021; OECD, 2023; Rahman et al., 2022). The interaction between communication gaps, limited resources, variable staff attitudes, and weak organizational systems creates a complex challenge that affects the quality and safety of radiology services.

These findings have important implications for hospital management and health policymakers. Strengthening policy implementation requires a comprehensive approach that integrates improved

communication strategies, increased availability and competency of radiographers, regular training programs, and stronger supervision and evaluation systems (WHO, 2022; IAEA, 2021; OECD, 2023). In addition, fostering a strong safety culture and promoting accountability among healthcare workers are essential to ensure compliance with SOP and radiation protection standards (Vano et al., 2021; Alotaibi et al., 2022). By addressing these factors, healthcare facilities can enhance the quality of radiology services, improve patient safety, and reduce the risks associated with radiation exposure.

CONCLUSIONS

The implementation of the C-Arm Fluoroscopy procedure policy at RSUD Jend. A. Yani Metro in 2026 has not yet been fully optimal. Although standard operating procedures and supporting infrastructure are available, gaps remain in their practical implementation. Key challenges were identified in communication, particularly the lack of consistent SOP dissemination; limited human resources, especially the shortage of radiographers; varying levels of staff compliance and commitment to radiation safety; and weak supervision and monitoring systems within the organizational structure.

These factors contribute to inconsistencies in practice, including deviations from SOP and suboptimal radiation protection measures, which may impact service quality and patient safety. Therefore, strengthening communication strategies, increasing the number and competency of radiographers, enhancing training and awareness programs, and improving supervision and evaluation mechanisms are essential steps to ensure effective policy implementation. A comprehensive and integrated approach is needed to improve compliance, enhance radiation safety, and ensure high-quality radiology services in hospital settings.

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