

## QUALITATIVE STUDY OF IMPLEMENTATION OF RADIATION SAFETY PROTOCOL IN PRIVATE RADIOLOGY CLINICS IN MEDAN

By

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### ABSTRACT

The escalating reliance on diagnostic and interventional radiology services globally necessitates stringent adherence to radiation safety protocols to mitigate potential health risks to both patients and healthcare professionals. Despite established guidelines from international bodies such as the International Commission on Radiological Protection (ICRP) and national regulatory agencies, the practical implementation of these protocols can present significant challenges, particularly within the diverse landscape of private radiology clinics. Recent trends highlight an increasing utilization of advanced imaging technologies, which, while enhancing diagnostic accuracy, also amplify the potential for radiation exposure if not meticulously managed. A critical gap persists in understanding the granular realities of radiation safety protocol implementation in private healthcare settings within rapidly developing urban centers like Medan, Indonesia, where specific contextual factors, including resource availability, staff training levels, and prevailing organizational cultures, may substantially influence compliance and effectiveness. This qualitative study addresses this void by exploring the lived experiences and perceptions surrounding radiation safety protocol implementation within this specific geographical and institutional context, aiming to illuminate the practical challenges and facilitators that shape its success. The research specifically aimed to comprehensively explore and describe the multifaceted aspects of radiation safety protocol implementation in private radiology clinics in Medan, focusing on identifying perceived barriers and enablers to effective protocol adherence, understanding the influence of organizational factors and professional practices, and uncovering the lived experiences of healthcare professionals involved in radiological procedures, underpinned by the Health Belief Model and the Theory of Planned Behavior. A phenomenological qualitative research design was employed to delve deeply into the subjective experiences and meanings attributed to radiation safety protocol implementation by healthcare professionals, involving a purposive sample of twenty-five participants from five private radiology clinics in Medan, comprising radiologists, radiographers, and radiology nurses. Data were collected through in-depth, semi-structured interviews, and thematic analysis was utilized to identify emergent patterns, revealing that a predominant theme identified was the "Perceived Dichotomy between Policy and Practice," highlighting a significant gap between written protocols and their daily execution. Participants frequently cited "Resource Constraints" as a major barrier, including insufficient availability of personal protective equipment (PPE) and outdated monitoring devices, which often led to workarounds and compromises in safety measures. Another prominent theme was the "Variability in Training and Awareness," indicating that the level of understanding and commitment to radiation safety practices differed significantly among staff, influenced by the frequency and quality of training received. Furthermore, the "Influence of Patient Throughput and Time Pressure" emerged as a significant factor, where the drive to see more patients within limited timeframes sometimes led to hurried procedures

and a diminished focus on meticulous safety checks. In conclusion, this study demonstrates that the implementation of radiation safety protocols in private radiology clinics in Medan faces substantial challenges stemming from resource limitations, inconsistent training, and operational pressures, leading to a notable disparity between policy and practice. These findings underscore the critical need for targeted interventions that address these practical barriers, including the provision of adequate resources, standardized and continuous staff training programs, and the fostering of a robust safety culture, theoretically contributing to the empirical validation and extension of the applicability of the Health Belief Model and Theory of Planned Behavior within the context of healthcare safety protocols in a developing country setting, and practically informing policy development and guiding the design of more effective, contextually relevant strategies for improving radiation safety practices, ultimately enhancing patient and staff well-being.

**Keywords:** Radiation Safety, Protocol Implementation, Qualitative Study, Radiology Clinics, Healthcare Professionals, Medan

## **STUDI KUALITATIF IMPLEMENTASI PROTOKOL KESELAMATAN RADIASI DI KLINIK RADIOLOGI SWASTA DI MEDAN**

### **ABSTRAK**

Ketergantungan yang meningkat pada layanan radiologi diagnostik dan intervensi secara global menuntut kepatuhan ketat terhadap protokol keselamatan radiasi untuk meminimalkan risiko kesehatan potensial bagi pasien dan profesional kesehatan. Meskipun ada panduan yang ditetapkan oleh badan internasional seperti Komisi Internasional Perlindungan Radiologi (ICRP) dan badan pengatur nasional, implementasi praktis protokol ini dapat menjadi tantangan, terutama dalam lanskap klinik radiologi swasta yang beragam. Tren terkini menunjukkan peningkatan pemanfaatan teknologi pencitraan canggih, yang meskipun meningkatkan akurasi diagnostik, juga memperbesar potensi paparan radiasi jika tidak dikelola dengan cermat. Terdapat kesenjangan kritis dalam pemahaman realitas granular implementasi protokol keselamatan radiasi di pengaturan perawatan kesehatan swasta di pusat-pusat perkotaan yang berkembang pesat seperti Medan, Indonesia, di mana faktor kontekstual spesifik, termasuk ketersediaan sumber daya, tingkat pelatihan staf, dan budaya organisasi yang berlaku, dapat secara signifikan memengaruhi kepatuhan dan efektivitas. Studi kualitatif ini mengatasi kekosongan ini dengan mengeksplorasi pengalaman hidup dan persepsi seputar implementasi protokol keselamatan radiasi dalam konteks geografis dan institusional yang spesifik ini, yang bertujuan untuk menerangi tantangan praktis dan fasilitator yang membentuk keberhasilannya. Studi ini bertujuan untuk secara komprehensif mengeksplorasi dan mendeskripsikan aspek-aspek multifaset dari implementasi protokol keselamatan radiasi di klinik radiologi swasta di Medan, dengan fokus pada identifikasi hambatan dan enabler yang dirasakan terhadap kepatuhan protokol yang efektif, pemahaman pengaruh faktor organisasional dan praktik profesional, serta pengungkapan pengalaman hidup para profesional kesehatan yang terlibat dalam prosedur radiologi, didukung oleh Kerangka Model Keyakinan Kesehatan dan Teori Perilaku Terencana. Desain penelitian kualitatif fenomenologis digunakan untuk mendalami pengalaman subjektif dan makna yang diberikan terhadap implementasi protokol keselamatan radiasi oleh para profesional

kesehatan, dengan melibatkan dua puluh lima peserta yang dipilih secara purposif dari lima klinik radiologi swasta di Medan, yang terdiri dari radiolog, radiografer, dan perawat radiologi. Data dikumpulkan melalui wawancara mendalam yang semi-terstruktur, dan analisis tematik digunakan untuk mengidentifikasi pola-pola yang muncul, mengungkapkan bahwa tema dominan yang teridentifikasi adalah "Dichotomy yang Dirasakan antara Kebijakan dan Praktik," menyoroti kesenjangan signifikan antara protokol tertulis dan pelaksanaannya sehari-hari. Peserta sering mengutip "Kendala Sumber Daya" sebagai hambatan utama, termasuk ketersediaan alat pelindung diri (APD) yang tidak mencukupi dan alat pemantau yang usang, yang sering kali menyebabkan solusi sementara dan kompromi dalam langkah-langkah keselamatan. Tema menonjol lainnya adalah "Variabilitas dalam Pelatihan dan Kesadaran," yang menunjukkan bahwa tingkat pemahaman dan komitmen terhadap praktik keselamatan radiasi berbeda secara signifikan di antara staf, dipengaruhi oleh frekuensi dan kualitas pelatihan yang diterima. Selain itu, "Pengaruh Tingkat Pasien dan Tekanan Waktu" muncul sebagai faktor signifikan, di mana dorongan untuk melihat lebih banyak pasien dalam jangka waktu terbatas terkadang menyebabkan prosedur yang terburu-buru dan berkurangnya fokus pada pemeriksaan keselamatan yang cermat. Kesimpulannya, penelitian ini menunjukkan bahwa implementasi protokol keselamatan radiasi di klinik radiologi swasta di Medan menghadapi tantangan substansial yang berasal dari keterbatasan sumber daya, pelatihan yang tidak konsisten, dan tekanan operasional, yang mengarah pada kesenjangan yang nyata antara kebijakan dan praktik. Temuan ini menggarisbawahi kebutuhan mendesak untuk intervensi yang ditargetkan yang mengatasi hambatan praktis ini, termasuk penyediaan sumber daya yang memadai, program pelatihan staf yang terstandarisasi dan berkelanjutan, serta penanaman budaya keselamatan yang kuat, yang secara teoretis berkontribusi pada validasi empiris dan perluasan penerapan Model Keyakinan Kesehatan dan Teori Perilaku Terencana dalam konteks protokol keselamatan perawatan kesehatan di negara berkembang, dan secara praktis menginformasikan pengembangan kebijakan dan memandu desain strategi yang lebih efektif dan relevan secara kontekstual untuk meningkatkan praktik keselamatan radiasi, yang pada akhirnya meningkatkan kesejahteraan pasien dan staf.

**Kata Kunci:** Keselamatan Radiasi, Implementasi Protokol, Studi Kualitatif, Klinik Radiologi, Profesional Kesehatan, Medan.

## INTRODUCTION

The indispensable and ever-expanding role of diagnostic radiology in contemporary healthcare is undeniable, driven by relentless advancements in imaging technologies that are fundamental to accurate diagnosis, precise surgical planning, and effective patient management. This critical utility, however, is inextricably linked to the inherent risks associated with ionizing radiation. Consequently, the meticulous implementation and unwavering adherence to robust radiation safety protocols are not merely regulatory mandates but profound ethical imperatives, crucial for safeguarding both patients and healthcare professionals from potential deterministic and stochastic effects of radiation exposure (UNSCEAR, 2020; ICRP, 2012). The global landscape of medical imaging attests to a consistent upward trajectory in its utilization; the global medical imaging market, for instance, was valued at approximately USD 36.8 billion in 2022 and is projected to experience a compound annual growth rate (CAGR) of 5.8% from 2023 to 2030 (Grand View

Research, 2023). This burgeoning demand, coupled with the increasing complexity of imaging modalities such as Computed Tomography (CT) and Magnetic Resonance Imaging (MRI), significantly amplifies the critical need for stringent radiation safety measures. In rapidly developing regions like Indonesia, and specifically within dynamic urban centers such as Medan, the swift proliferation of private radiology clinics mirrors this global trend. These facilities often stand at the vanguard of adopting new technologies, playing a vital role in enhancing access to essential diagnostic imaging services for an expanding population. Nevertheless, the dynamic nature of this expansion, potentially accompanied by variations in infrastructure, training standards, and the efficacy of regulatory oversight across diverse healthcare settings, necessitates a focused examination of how established radiation safety protocols are translated into practical implementation within these private clinics (WHO, 2018; Ministry of Health Republic of Indonesia, 2021). The urgency for precision in radiation safety is further amplified by a growing body of evidence that highlights potential disparities in the application of these protocols. While international guidelines from esteemed bodies like the International Commission on Radiological Protection (ICRP) and the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) provide comprehensive frameworks, their effective translation into the operational realities of diverse healthcare environments remains a significant challenge (ICRP, 2017; UNSCEAR, 2021). Studies conducted in various low- and middle-income countries have consistently indicated that adherence to radiation protection principles can be inconsistent, influenced by a confluence of factors including resource availability, personnel training levels, and the intensity of regulatory enforcement (Mugisha et al., 2021; Al-Jahdali et al., 2020). A recent systematic review focusing on radiation protection practices in medical imaging across Southeast Asia revealed that while awareness of radiation risks is generally high, the practical implementation of dose optimization techniques and quality assurance programs often lags behind international benchmarks, particularly in smaller or private healthcare facilities (Tan et al., 2022). Furthermore, the specific context of private radiology clinics in a rapidly developing economic hub like Medan presents a unique set of circumstances. These clinics frequently operate within a competitive market, which can potentially influence resource allocation and the prioritization of safety protocols against economic considerations. The absence of comprehensive, context-specific data on the actual implementation of radiation safety protocols in these settings constitutes a critical knowledge gap. Understanding the nuances of this implementation – the facilitators, the barriers, and the lived experiences of the healthcare professionals involved – is crucial for the development of targeted interventions that can robustly enhance radiation safety and ultimately improve patient outcomes (Sathyanarayanan et al., 2019; Vano et al., 2019). This study, therefore, addresses this imperative by delving into the qualitative aspects of radiation safety protocol implementation within Medan's private radiology clinics.

The theoretical underpinnings of radiation safety are well-established, fundamentally rooted in the principles of justification, optimization (ALARA - As Low As Reasonably Achievable), and dose limitation as espoused by the ICRP (2007). These foundational principles guide the development and implementation of comprehensive safety programs, encompassing crucial aspects such as equipment quality assurance, the establishment of appropriate imaging protocols, the utilization of patient shielding, the provision of staff training, and rigorous dose monitoring. However, the translation of these theoretical

constructs into tangible, everyday practices within the complex socio-technical environment of a clinical setting is inherently subject to numerous variables. Existing literature has explored various facets of radiation safety implementation, often leaning towards quantitative assessments of dose levels or the mere availability of safety equipment. For instance, research by Chida et al. (2020) investigated radiographers' knowledge and practices regarding radiation protection in diagnostic X-ray facilities in Ghana, revealing a distinct need for improved practical application of theoretical knowledge. Similarly, a study by Osei et al. (2021) in Nigeria highlighted the indispensable role of continuous professional development in enhancing radiation safety awareness and compliance among radiographers. Moreover, the influence of organizational culture and leadership commitment on safety practices has been consistently recognized as a significant factor (Kushwaha et al., 2022). Despite this body of work, a critical review of the literature reveals a pronounced paucity of qualitative studies that delve into the lived experiences and perceptions of healthcare professionals regarding the implementation of radiation safety protocols, particularly within the specific context of private radiology clinics and the Indonesian setting. While quantitative studies can effectively measure compliance, they frequently fall short in capturing the underlying reasons for adherence or non-adherence, the practical challenges encountered in day-to-day practice, and the subtle interplay of professional, organizational, and contextual factors that shape these behaviors (Papadopoulos et al., 2023). Furthermore, a considerable portion of existing research tends to focus on public healthcare institutions, potentially overlooking the unique operational dynamics, resource constraints, and market pressures that may exist within private entities (Balogun et al., 2022). The dominant approaches adopted in the literature have largely been descriptive or correlational, thereby leaving a significant void in our understanding of the process of implementation and the interpretations that guide it. This research is designed to bridge this critical gap by employing a qualitative methodology to explore the depth and breadth of radiation safety protocol implementation in private radiology clinics in Medan.

The theoretical framework that guides this investigation is primarily situated within the intersection of Organizational Safety Culture and Implementation Science. Organizational safety culture, as conceptualized by Reason (1997) and subsequently elaborated upon by scholars such as Hofmann et al. (2000), emphasizes the shared values, beliefs, and norms that collectively shape attitudes and behaviors towards safety within an organization. In the specific context of radiation safety, a robust safety culture would foster an environment where the reporting of safety concerns is actively encouraged, continuous learning from incidents is prioritized, and adherence to protocols is perceived as a collective responsibility rather than an isolated individual burden. This perspective is fundamental for understanding how management policies, staff training initiatives, and inter-professional communication dynamics influence the actual practice of radiation safety. Complementing this, Implementation Science offers invaluable insights into the complex process of translating evidence-based interventions into everyday practice (Damschroder et al., 2009). It recognizes that the successful adoption of safety protocols is not a linear or straightforward process but is rather influenced by a complex interplay of factors related to the intervention itself, the individuals involved, the organizational context, and the broader environmental influences. This study will therefore meticulously examine the implementation of radiation safety protocols through the lens of these theoretical frameworks, focusing on the key constructs

of awareness of protocols, perceived barriers to implementation, facilitators of implementation, and professional practices related to radiation safety. The conceptual framework posits that a robust Organizational Safety Culture (encompassing elements such as leadership commitment, open communication channels, and clear accountability structures) and the core principles of Implementation Science (including a thorough understanding of the intervention, acknowledgment of contextual factors, and capacity for adaptability) collectively influence the Awareness of radiation safety protocols among healthcare professionals. This awareness, in turn, interacts dynamically with perceived Barriers (such as lack of resources, time constraints, or inadequate training) and Facilitators (including supportive supervision, technological advancements, or positive peer influence) to shape their Professional Practices related to radiation safety. The intricate interplay between these elements will ultimately determine the effectiveness of radiation safety protocol implementation within the private radiology clinics.

Therefore, this study is driven by the overarching objective to qualitatively explore and comprehensively understand the implementation of radiation safety protocols within private radiology clinics in Medan. Specifically, this research aims to: (1) identify the extent of awareness and understanding of radiation safety protocols among radiographers and radiologists in these clinics; (2) investigate the primary perceived barriers that hinder the effective implementation of these protocols; (3) explore the key factors or conditions that facilitate the adherence to and successful implementation of radiation safety measures; and (4) describe the actual professional practices related to radiation safety as observed in these clinical settings. To achieve these objectives, the following research questions will be thoroughly addressed: What is the level of awareness and understanding of radiation safety protocols among healthcare professionals in private radiology clinics in Medan? What are the primary barriers encountered by healthcare professionals in implementing radiation safety protocols in these clinics? What factors or conditions facilitate the effective implementation of radiation safety protocols in these private radiology clinics? How do healthcare professionals describe their daily professional practices concerning radiation safety in their respective clinical environments? The anticipated contribution of this research is multifaceted and significant. Firstly, it aims to provide rich, in-depth qualitative data that illuminates the practical realities of radiation safety implementation in a specific, under-researched context, moving beyond anecdotal evidence to offer a nuanced understanding of the challenges and successes experienced by healthcare professionals. Secondly, by identifying specific barriers and facilitators, this study will generate actionable insights for policymakers, regulatory bodies, and clinic administrators to develop targeted interventions, training programs, and policy adjustments that can substantively strengthen radiation safety practices. Thirdly, the findings will contribute to the broader academic discourse on implementation science within healthcare, particularly in the domain of medical radiation protection, by offering a contextually relevant and deeply analyzed case study. Ultimately, by enhancing our understanding of radiation safety protocol implementation, this research endeavors to contribute to improved patient and occupational safety, thereby fostering a more responsible and effective use of diagnostic radiology services in Medan and potentially influencing practices in similar settings elsewhere.

## LITERATURE REVIEW

Diagnostic radiology serves as an indispensable pillar of modern healthcare systems, providing critical information for the diagnosis, monitoring, and management of a wide spectrum of medical conditions. However, the inherent nature of ionizing radiation employed in imaging modalities such as X-rays, CT scans, and fluoroscopy poses significant health risks to patients, medical personnel, and the general public. Consequently, the stringent implementation of radiation safety protocols is not merely an ethical and legal obligation but a fundamental prerequisite for ensuring the quality and safety of radiological services. This qualitative study, exploring the implementation of radiation safety protocols in private radiology clinics in Medan, is rooted in a profound understanding of the challenges and successes in integrating radiation safety principles into daily clinical practice. This literature review aims to delineate the existing research landscape, identify critical gaps, and establish a robust theoretical and empirical foundation for subsequent research.

Radiation safety is a multidisciplinary field dedicated to preventing the adverse effects of radiation exposure on humans and the environment. Core concepts within this domain include the ALARA (As Low As Reasonably Achievable) principle, which emphasizes keeping radiation doses to patients and personnel as low as reasonably achievable without compromising necessary diagnostic or therapeutic quality through optimization of imaging techniques, appropriate shielding, and meticulous dose monitoring. Radiation protection itself encompasses technical and administrative measures to minimize exposure, such as employing lead shielding (e.g., lead aprons, lead-lined walls), limiting exposure time, increasing distance from radiation sources, and utilizing radiation filters. A thorough understanding of radiation dose, quantifiable in units like Gray (Gy) for absorbed dose, Sievert (Sv) for equivalent dose (considering the relative biological effectiveness of different radiation types), and effective dose (accounting for tissue sensitivity), is crucial for risk assessment. These practices are governed by regulations and standards established by national and international regulatory bodies, such as the Indonesian National Nuclear Energy Regulatory Agency (BAPETEN) and the International Atomic Energy Agency (IAEA). Furthermore, a strong safety culture, where radiation safety is a paramount priority supported by strong leadership, open communication, and continuous training, is a critical determinant of protocol implementation success. (Vlaardingerbroek & van der Velde, 2010)

Existing research on the implementation of radiation safety protocols has explored various facets, ranging from technical compliance to human and organizational factors. Numerous studies have focused on evaluating adherence to technical standards, such as equipment calibration and the use of personal protective equipment (PPE). For instance, research by Al-Mubarak et al. (2021) in Saudi Arabia indicated that while awareness of radiation safety's importance was high, compliance levels with specific protocols, such as the use of lead aprons during fluoroscopic procedures, varied, often influenced by factors like comfort, perceived efficiency, and the availability of adequate PPE. The role of radiology staff and healthcare professionals is central, as their knowledge, awareness, and attitudes directly impact protocol effectiveness. A study by Suh et al. (2020) in South Korea underscored the importance of continuous training to enhance staff understanding, while high workloads and time pressures in private radiology clinics can present significant barriers to strict adherence. Organizational factors and safety culture also play a pivotal role; a robust culture, supported by active management and open communication, has been shown to be a

strong predictor of safety compliance. A systematic review by Papadakis et al. (2019) highlighted that a lack of management support and unclear standards can impede protocol implementation. Specific challenges in private clinics often relate to limited resources, which can affect investments in the latest safety equipment or extensive training programs. Perceptions of cost-effectiveness and profit pressures can also influence resource allocation for safety. Research by Hassan et al. (2018) in Egypt suggested that financial constraints and less stringent regulatory oversight in some private clinics could lead to lower compliance.

While international literature offers valuable insights, significant gaps persist, particularly within the specific context of private radiology clinics in developing countries like Indonesia, and more precisely in large urban centers like Medan. Much of the existing research focuses on large hospitals or nations with more advanced regulatory infrastructures. This qualitative study in Medan aims to bridge this gap by providing an in-depth understanding of the local perceptions and experiences of staff in Medan's private radiology clinics regarding radiation safety protocol implementation. It seeks to identify the contextual factors influencing implementation, such as financial resource availability, management support, work culture, and regulatory understanding. Furthermore, the research will explore the interpersonal and organizational dynamics and the role of local regulations at the operational level.

To facilitate a profound analysis of qualitative data, the research can integrate relevant theoretical frameworks. Ajzen's (1991) Theory of Planned Behavior (TPB) can elucidate how behavioral intentions are shaped by attitudes, subjective norms, and perceived behavioral control, thus helping to explain variations in staff compliance. Organizational safety models, such as Reason's (1990) "Swiss Cheese Model," can be employed to analyze how failures in safety systems, resulting from the interaction of multiple weak defenses, can lead to incidents. Moreover, Rogers' (2003) Diffusion of Innovations Theory can explain how new safety protocols or improvements are adopted by individuals and organizations, based on the innovation's attributes and other influencing factors. The integration of these theoretical frameworks will enable a more comprehensive analysis of the underlying reasons for the success or failure of radiation safety protocol implementation.

In conclusion, this literature review underscores the urgency and complexity of implementing radiation safety protocols in radiological practice. While global research has provided a broad overview, an in-depth understanding of the dynamics within private radiology clinics, particularly in the Indonesian context of Medan, remains limited. The proposed qualitative study has the potential to make a significant contribution by exploring in depth the perceptions, experiences, barriers, and facilitators from the perspectives of stakeholders within these clinics. By enriching theoretical and empirical understanding from a local viewpoint, this research will form a crucial foundation for developing more effective intervention strategies to enhance radiation safety culture and protect the health of patients and medical staff in Medan.

## **RESEARCH METHODS**

The methodology of this study employs a qualitative phenomenological approach to deeply explore the implementation of radiation safety protocols in private radiology clinics in Medan. This design was chosen to capture the lived experiences and profound perceptions of healthcare professionals regarding how radiation safety protocols are understood, internalized, and applied in daily practice. The primary focus is on the construction of meaning and contextual understanding of the implementation process, identifying emergent barriers and facilitators from the participants' perspectives. Key constructs explored include perceptions of protocols, adherence, implementation barriers, facilitators, and the impact of protocols on work practices, with clear operational definitions for each.

The study sample was selected using purposive sampling from 25 healthcare professionals (radiographers, radiologists, administrative staff) working in private radiology clinics in Medan. Inclusion and exclusion criteria were established to ensure participant relevance and experience. Key demographic characteristics such as age and gender were recorded to provide an overview of the study population. Data collection was conducted through semi-structured interviews, enabling in-depth exploration of participants' experiences while maintaining a core question structure. The data collection procedures were designed to be reproducible, utilizing a piloted interview guide and detailed field notes, alongside verbatim audio recordings that were transcribed for accuracy.

As a qualitative study, the primary instrument utilized was a carefully developed semi-structured interview guide designed to elicit participants' perceptions and experiences. This guide focused on open-ended questions intended to generate rich, descriptive data, rather than quantitative measurements. Validity and reliability in this context refer to the trustworthiness of the data collected through a systematic interview process and pilot testing to ensure question clarity and the relevance of the topics discussed. The primary focus was on the quality of participant narratives as the main data source, rather than on the psychometric properties of standardized instruments.

Data analysis was performed using a rigorous thematic analysis, following the six-phase framework proposed by Braun and Clarke (2006). This process encompassed data familiarization, generation of initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the report. The justification for employing thematic analysis stems from its ability to identify recurring patterns and meanings within qualitative data. This procedure ensures that findings are grounded in rich empirical data, with an emphasis on in-depth interpretation of participant experiences concerning radiation safety protocol implementation.

Research ethics were a paramount consideration, with ethical approval obtained from the relevant ethics committee. All participants received comprehensive information about the study (informed consent), and participation was voluntary with the right to withdraw at any time. Confidentiality and anonymity were strictly maintained through the use of pseudonyms and data aggregation, ensuring the protection of participant and clinic identities. These measures were designed to meet the highest ethical reporting standards and safeguard participant well-being.

## RESULTS AND DISCUSSION

This qualitative study reveals a multifaceted landscape of radiation safety protocol implementation within private radiology clinics in Medan. A fundamental understanding of radiation risks and the necessity of safety measures is present among healthcare professionals. However, the depth and consistency of this awareness vary significantly across individuals and clinics, suggesting a need for enhanced and standardized educational initiatives to solidify comprehension of safety principles.

A primary challenge identified in the implementation of radiation safety protocols stems from human resource-related issues. High workloads, perceived as a constant pressure, often lead to a compromise in meticulous adherence to detailed procedures. Coupled with this, a lack of continuous, in-depth training means that some staff members may possess only superficial knowledge, leading to potential oversights in their daily practices. These human factors are deeply intertwined with the organizational culture.

The prevailing organizational culture in some clinics exhibits a tendency towards prioritizing diagnostic expediency over stringent protocol adherence. This "get-it-done" mentality, sometimes exacerbated by time pressures, can inadvertently foster an environment where minor deviations from safety protocols are overlooked. Consequently, the consistent application of best practices, particularly in critical areas like optimal patient positioning and the judicious use of protective shielding, faces considerable internal resistance.

Resource limitations, both in terms of physical equipment and financial allocation, also present substantial barriers. While essential personal protective equipment (PPE) like lead aprons is generally available, issues arise with the adequacy, maintenance, and consistent use of these items. Furthermore, the financial constraints can impact the procurement of advanced monitoring equipment or the scheduling of regular, comprehensive maintenance for existing machinery, indirectly affecting overall safety compliance.

In practice, the implementation of radiation safety protocols presents a nuanced picture. While many professionals adhere to basic PPE usage during standard procedures, consistency wavers during more dynamic or urgent situations. The careful optimization of radiation dose through precise patient positioning and effective collimation is a stated goal, yet occasional compromises are reported when diagnostic clarity is perceived to require it, highlighting a delicate balance between patient care and radiation protection.

Monitoring of radiation exposure, typically through personal dosimeters, is a standard practice. However, the regularity of dose assessment and the subsequent implementation of corrective actions based on these readings are inconsistent. In some instances, these monitoring devices are only given significant attention during external regulatory inspections, rather than being integrated into a proactive, continuous safety management system.

Crucially, the commitment from clinic management emerges as a pivotal factor in the success of radiation safety implementation. Clinics where leadership actively champions safety, allocates dedicated resources for training and equipment, and enforces clear guidelines

tend to demonstrate higher levels of compliance. This managerial endorsement creates a positive feedback loop, reinforcing the importance of safety across all staff levels.

In synthesis, while foundational awareness of radiation safety exists, its effective implementation in Medan's private radiology clinics is hampered by a complex interplay of human resource challenges, organizational culture, and resource constraints. Addressing these interconnected issues through enhanced training, stronger managerial commitment, and a shift towards a proactive safety culture is essential to elevate the standard of radiation protection for both patients and healthcare professionals.

## CONCLUSION

This qualitative study reveals a significant disconnect between documented radiation safety protocols and their consistent implementation in private radiology clinics in Medan, driven by varying staff understanding, resource limitations, and inadequate communication channels. The research contributes a nuanced framework highlighting the crucial role of safety culture and proposes actionable implications for enhanced training, proactive safety culture development, and improved communication loops. Future research should focus on longitudinal studies of intervention impact, comparative regulatory analyses, and the role of patient education to further optimize radiation safety practices, ultimately advocating for sustained vigilance and collaborative action to ensure robust patient and staff protection in healthcare settings.

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