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Systematic Review

Strategies and barriers in radiation risk communication in medical imaging: A scoping review of radiographers' practices

N.A. Angaag [a,i], S. Sey [b], J. Armo [c,d], J.L. Ago [e,f,g,h,*,i]

[a] Radiology Unit, Department of Medical Care, Holy Family Catholic Polyclinic – Kulmasa, Savannah Region, Ghana
[b] School of Science and Engineering, University of Dundee – Dundee, United Kingdom
[c] Neuroimaging Department, Institute of Psychiatry, Psychology and Neuroscience, King's College London – London, United Kingdom
[d] Department of Radiology, Komfo Anokye Teaching Hospital – Kumasi, Ashanti Region, Ghana
[e] School of Dentistry & Medical Sciences, Faculty of Science & Health, Charles Sturt University, Port Macquarie, NSW 2444, Australia
[f] Discipline of Medical Radiations, School of Health and Biomedical Sciences, RMIT University, Bundoora, VIC 3083, Australia
[g] Teaching Innovation in Radiography Group, Charles Sturt University, Wagga Wagga, NSW 2678, Australia
[h] Department of Medical Imaging Technology, Faculty of Applied Sciences, Accra Technical University, Accra, Ghana

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ABSTRACT

Introduction: Radiation risk communication allows patients to make an informed decision, enhancing their autonomy during diagnostic imaging procedures. It can also reduce anxiety and improve patient cooperation. However, evidence suggests that radiographers often provide inadequate or unclear information about radiation risks. Several barriers further limit effective communication, thereby undermining patient awareness, informed decision-making, and overall patient-centred care. This study explored strategies and barriers in radiation risk communication.

Methods: A scoping review was conducted using Arksey and O'Malley's framework and reported in line with PRISMA-ScR. Literature searches were performed in PubMed, Scopus, and Web of Science. Included studies focused on professional guidelines and empirical evidence on radiation risk communication.

Results: Thematic analysis identified three key themes: (i) radiation risk communication approaches, (ii) barriers to effective communication, and (iii) needs for development in communication practice. Radiographers predominantly used active or passive verbal communication approaches when discussing radiation risks. Key barriers included fear of causing patient anxiety, limited knowledge and low confidence in risk communication, ambiguity in role responsibility, and lack of appropriate resources. Recommended areas for improvement included enhanced radiographer education and training, use of interactive communication strategies, and incorporation of supportive materials such as posters and patient information leaflets.

Conclusion: Radiation risk communication practices among radiographers remain inconsistent and often inadequate despite their central role in patient education and informed consent. Standardised protocols and institutional support are required to improve consistency, clarity, and effectiveness of communication in clinical practice.

Implications for practice: Strengthening education and training in radiation risk communication, clarifying professional roles, and implementing structured communication protocols alongside supportive patient education materials can improve patient understanding, enhance informed consent, and strengthen trust while promoting safer, patient-centred care.

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Introduction

Since the introduction of X-rays in medicine, diagnostic imaging has significantly improved healthcare services and patient outcomes. However, many diagnostic imaging modalities rely heavily on the use of ionising radiation. The potential danger of

* Corresponding author. Discipline of Medical Radiation Science, School of Dentistry & Medicine, Faculty of Science and Health, Charles Sturt University, Port Macquarie, NSW 2444, Australia.
E-mail addresses: jago@csu.edu.au, jacobleonardago@gmail.com (J.L. Ago).
[i] Equal contribution.

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ionising radiation on biological tissues, concerns about its long-term effects, and reports of inappropriate examinations have made it necessary to ensure that every exposure to ionising radiation for medical purposes is justified.[1,2] It is recommended that the justification process be facilitated by awareness, appropriateness and audit.[1] Referring clinicians, radiographers, and radiologists are involved in the justification process, although a lack of awareness and education among them are barriers to its effectiveness.[3,4] Patients may also have a role to play as their effective communication with radiographers will ensure that awareness of (i) the justification process, (ii) the patient's history to necessitate the selection of correct protocols, and (iii) radiation risk, is done appropriately.

Radiation risk communication can be defined as sharing information about the recommended diagnostic imaging examinations, benefits and risks, and alternative imaging modalities with patients.[5] Such communication allows patients to make an informed decision, thereby enhancing their autonomy during diagnostic imaging procedures. Additionally, appropriate information may reduce patient anxiety and enhance cooperation.[6] However, studies conducted globally indicate that radiographers provide patients with inadequate or unclear information about radiation risks.[5,7–11] This phenomenon is attributed to factors such as anxiety,[7] not wanting to scare or discourage patients,[8,9] time constraints,[7] and inadequate knowledge about radiation risk.[9] Other factors include the perception that the referring clinician has done the necessary communication, and such information is considered unnecessary.[7,8] These challenges hinder patient awareness, informed decision-making, and negatively impact patient-centred care.

To enhance patient outcomes, medical imaging procedures that rely on ionising radiation modalities require careful justification and effective communication of potential risks and benefits. Consequently, Newman[7] asserts that radiographers need to take a more active approach in providing patients with information about the potential risks as far as patient-centred care is concerned. Effective radiation risk communication between radiographers and patients may present challenges. For example, it may be difficult to accurately provide the exact dose of radiation a patient is exposed to in any procedure. Even if an accurate answer can be provided using the effective dose, patients may find it difficult to understand.[11] There is therefore the need to explore how radiographers currently communicate radiation risks, identifying the barriers they face, and develop practical strategies to enhance communication during radiographic examinations. In this scoping review, we seek to:

i. explore strategies used by radiographers in radiation risk communication to patients,
ii. examine the barriers that limit effective radiation risk communication in clinical radiography, and
iii. provide suggestions to improve radiation risk communication during radiographic examinations.

Risk communication in healthcare

Risk communication is a fundamental component of healthcare and plays a central role in shared decision-making and informed consent.[12,13] Effective communication of benefits, risks, and uncertainties enables patients to participate meaningfully in decisions regarding their care and has been associated with improved knowledge, treatment adherence, and patient engagement.[14] Furthermore, effective risk communication requires not only the clear presentation of probabilities and uncertainties[15] but also consideration of the emotional and cognitive factors that influence patient understanding and decision-making.[13,16] However, communicating risk remains inherently challenging for many reasons.[13] In terms of radiation risk communication, this may be closely associated with the tendency of patients to interpret information in line with their beliefs, experiences, emotions, and values.[14]

Risk communication challenges may be more pronounced in radiography because radiation exposure is invisible, probabilistic, and often difficult for patients to conceptualise. Furthermore, the term “radiation” may evoke fear and anxiety due to its association with cancer and nuclear incidents.[17] Consequently, effective radiation risk communication extends beyond the provision of factual information and requires radiographers to address patient concerns, foster trust, and communicate both benefits and risks in a clear and balanced manner.[17]

Methods

We adopted Arksey and O'Malley's[18] systematic scoping review approach and reported our search and selection outcomes using the PRISMA Extension for Scoping Reviews (PRISMA-ScR).[19] The Arksey and O'Malley's[18] scoping review framework involves (i) identifying the review questions, (ii) searching for relevant literature, (iii) collating, charting, and synthesising included studies/literature, and (iv) reporting the results.

Selection criteria

All studies on radiation risk communication among diagnostic radiographers were included if they were published in the English language. As well, professional guidelines on the subject matter were included. Opinion pieces, editorials, abstract-only or conference papers, commentaries, non-English language-published papers, and studies not directly related to medical imaging (for example, studies on radiation risk communication among industrial radiography or nuclear power plant workers) were excluded, as were studies involving non-diagnostic radiographers (e.g., therapy radiographers, radiologists, referring physicians, and nurses). The exclusion of non-English language papers was due to the language limitation of the authors and the uncertainty of translation by automated methods.[20]

Search strategy

We conducted our searches on PubMed, Scopus, and Web of Science (Fig. 1) in April 2025 using the following search terms: “radiograph*, “medical radiation”, “medical imaging” “radiologic technolog*”, “radiation risk communication”, “radiation exposure communication”, “patient radiation awareness”, and “radiation risk perception”. These terms were combined with Boolean characters (AND/OR) and the wildcard (?) to enhance the sensitivity of the search outcomes. Google Scholar was used to access other studies that were not identified in the initial search by manually screening the reference list of relevant studies. We did not restrict our search to publication year as we sought to include all available and eligible studies.

Screening, data extraction, and synthesis

Covidence was used to manage identified studies, including deduplication, title and abstract screening, full-text screening, and developing the PRISMA flow chart. Two review authors (SS and JA) independently screened all titles and abstracts, while a third review author (JLA) resolved any discrepancies. This was followed by

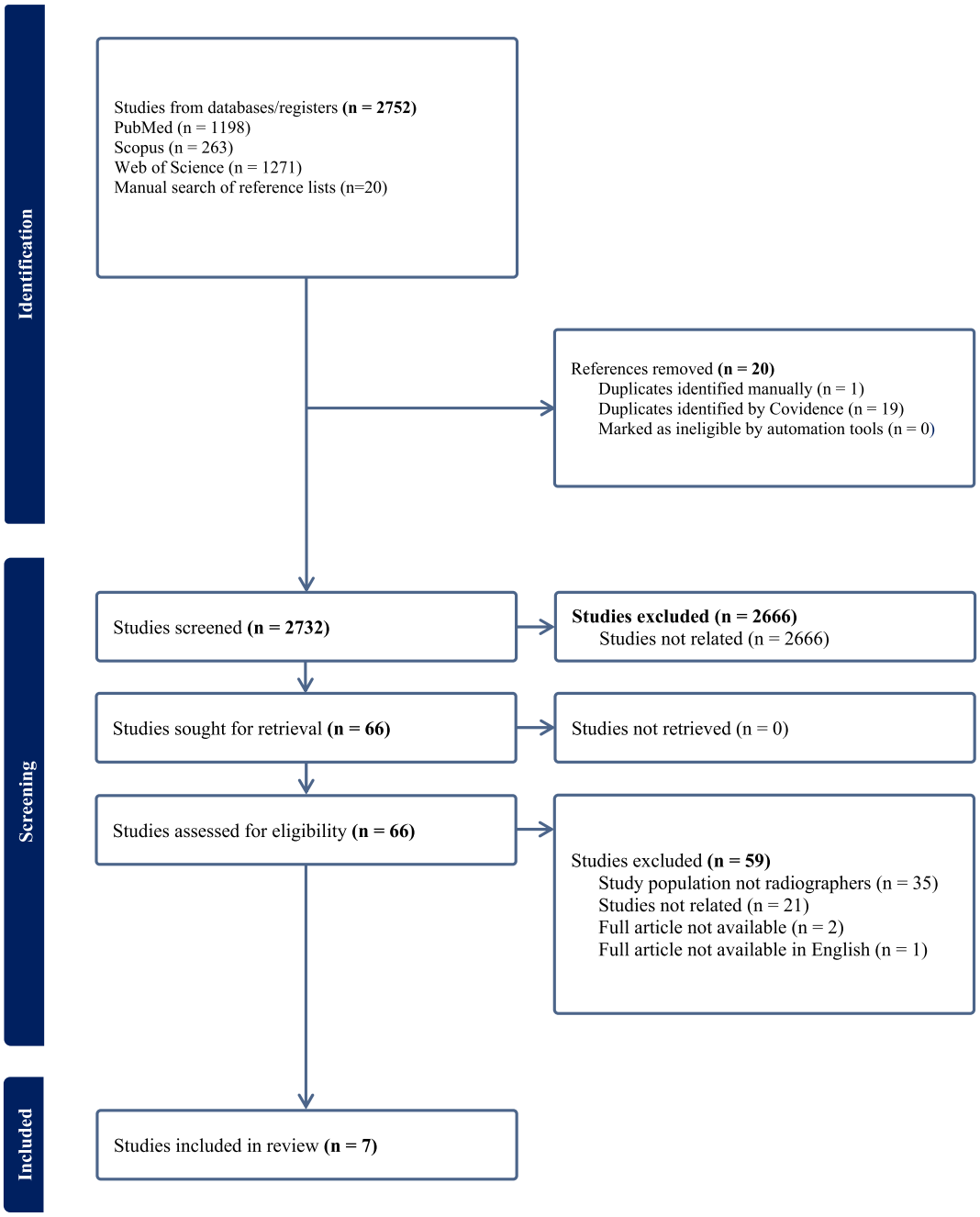

Figure 1. Flow diagram of search results.

full-text screening against the selection criteria, independently performed by SS and JA and conflicts mediated by NAA. Further, NAA and SS extracted relevant data from each of the included studies and synthesised them into key thematic findings. The data extraction included study characteristics such as information on author details, study type/design and sample size, aims/objectives, radiation risk communication strategy, key findings, and recommendations. No formal assessment of quality of included studies was undertaken, as it is an atypical feature of scoping reviews. A deductive thematic analysis was performed,[21] with the review objectives providing an initial analytical framework. Themes were then refined through iterative review of the extracted data. All review authors are diagnostic radiographers with clinical experience in general X-ray and computed tomography in diverse imaging settings. In addition, SS is a master's student in a medical imaging program, whilst JLA is a doctoral student in a medical radiation science program and holds a Master of Philosophy in Health Physics and Radiation Protection. These backgrounds and experiences shaped the analysis and discussion of the findings.

Results

Search outcome

The computerised search identified 2752 studies, of which 20 duplicates were removed. Further 2666 articles were excluded following title and abstract screening. After full-text screening,

only seven (7) met the selection criteria and were included in this review (Fig. 1).

The country of origin, study type, design and sample size, aim, radiation risk communication strategy, and recommendations of the included studies have been summarised in Table 1.

Thematic findings

A thematic analysis conducted found three main themes: (i) radiation risk communication approaches, (ii) barriers to effective radiation risk communication, and (iii) needs and development for radiation risk communication (Fig. 2).

Theme 1: radiation risk communication approaches

This theme was derived from four out of the seven included studies.[6,7,22,23] Three studies[6,7,23] reported that radiographers usually used an active or passive verbal approach in radiation risk communication. Active verbal communication generally referred to radiographers proactively discussing radiation risks as part of the examination process, whereas passive communication involved providing information only when patients asked questions or expressed concerns. However, the studies did not consistently specify whether proactive discussions occurred for all imaging examinations or were limited to higher-dose procedures. The extent to which radiographers adopted either approach appeared to depend on factors such as examination type, perceived radiation risk, patient information needs, and local practice requirements.[6,7,23] The study by McAleese et al.[22] was an action research focused on the implementation of a standardised communication tool and hence reported the use of posters as the communication strategy.

Theme 2: barriers to effective radiation risk communication

All the included studies highlighted barriers to effective radiation benefit-risk communication between radiographers and patients. Barriers included fear of causing anxiety or discouragement,[7,8,10] low knowledge level and confidence in radiation risk communication,[7,9,23] ambiguity in role responsibility,[6–8] and lack of appropriate resources (training, time, etc).[7]

Theme 3: needs and development for radiation risk communication

All the included studies provided recommendations on improving radiation risk communication between radiographers and patients. They included education for radiographers, using interactive communication methods, and the use of posters and materials.

Discussion

This review sought to (i) explore strategies used by radiographers in communicating radiation risks to patients and their relatives, (ii) examine the constraints to effective radiation risk communication in radiography practice, and (iii) provide suggestions to improve radiation risk communication. The findings of this review are discussed below, with emphasis on strategies to improve radiographer-patient communication to enhance diagnostic outcomes.

Theme 1: radiation risk communication approaches

The active involvement of radiographers in radiation risk communication supports informed decision-making and patient autonomy. Considering how important communication is, the approach used in communicating with patients is equally essential. Findings from this scoping review indicated that verbal communication approaches were widely used by radiographers, albeit there were variations in radiation risk communication practices irrespective of study site or design.[6,7,23] This may be advantageous in attending to patients of different cultural backgrounds as it will likely increase their understanding of the radiographic care process. As Kasraie and colleagues[24] assert, cultural sensitivity is vitally important in radiation risk communication to foster patient autonomy and engagement. However, this finding is also concerning in that it implies the absence of structured radiation risk communication practices for radiographers. It is important to note that the use of active communication approaches may not be frequently used in practice as these may increase patients' anxiety and X-ray hesitancy.[17] Consequently, some radiographers resorted to giving out benefit-risk information when asked by patients.[7] With the unstructured nature of communication, the verbal approach presents a more practical means to deliver information about radiation risks and benefits to patients and their significant others. Regardless, the findings suggest pitfalls such as inconsistencies in delivery of information via verbal communication (e.g, active versus passive approaches), selective disclosure in an attempt to lower patient anxiety, or knowledge and confidence gaps of radiographers. These limitations bring into question concerns about patient autonomy and informed consent.

McAleese et al.[22] explored the use of posters as part of a standardised tool for radiation risk communication among health professionals working in a surgical setting, and findings showed positive outcomes. It has been reported that patients appreciate written information about their diagnostic imaging procedures, including internet-based information linked to patient portals in addition to face-to-face communications.[25] Consequently, Applegate and Cost[26] indicate that a thoughtfully developed prospective handout can be an effective patient communication tool while also enhancing their autonomy. In line with these, the visual strategies (including the use of posters) could complement verbal communication, thereby offering patients clearer, more standardised information to support informed decision-making.

Theme 2: barriers to effective radiation risk communication

Findings from this review identified that fear among radiographers that openly discussing radiation risks may cause patient anxiety or discourage them from undergoing beneficial examinations – a phenomenon described as "X-ray hesitancy".[27] The authors emphasised that this phenomenon is prevalent in clinical practice and described three factors that may lead to patients being X-ray hesitant. The factors are (i) the concern that all radiation is harmful, seen in patients usually asking, "isn't radiation dangerous?", (ii) patients being hesitant due to previous examinations and their quest to avoid further exposures, and (iii) parental apprehension over the increased susceptibility of children to radiation effects. Consequently, these factors often lead to selective disclosure among some radiographers, resulting in the use of a passive approach.[7,10]

Table 1
Characteristics of included studies.

Author, country	Study type/design and sample size	Aim	Radiation risk communication strategy	Key findings	Recommendations
Hadley and Watson[6] United Kingdom	Quantitative, primary research 78 radiographers	To determine the role that computed tomography (CT) radiographers currently play in informed consent and whether they can provide accurate and appropriate information.	Active and passive verbal communication	Radiation risk-benefit communication had varied practices among radiographers.	• The use of written informed consent • The use of written information • Encouraging questions
Newman[7] United Kingdom	Mixed method, primary research 46 radiographers	To determine whether CT radiographers provide patients with information about cancer induction risks from CT scans and the rationale for their practices.	Passive verbal communication	CT radiographers took a passive approach to risk communication more often. This was due to being loosely focused on not wanting to discourage patients from having scans, a lack of time and a large gap in radiation risk knowledge.	• Training for radiographers • Provision of adequate resources to encourage risk communication among radiographers.
Ukkola et al.[8] Finland	Quantitative, primary research 174 radiographers	To investigate whether radiographers inform patients about radiation, and if not, the reasons for it.	Not indicated	Radiographers did not systematically discuss the radiation dose and the risks of the examinations with patients. The main reasons for not providing information are ignorance regarding responsibilities, the assumption that information is not needed, and concern about causing unnecessary fear.	• Interactive communication with patients • Education for radiographers • Developing and using practical guidelines • Digital educational material with video clips for public display
Reitan and Sanderud[9] Norway	Qualitative, primary research 6 radiographers	To investigate diagnostic radiographers' knowledge about radiation dose and risk, and their experiences of radiation risk communication.	Not indicated	This study shows that risk communication among radiographers is challenging, and the key challenge is the lack of knowledge of radiation doses and the lack of experience in risk communication. There is a need for increased focus and knowledge of radiation dose and risk, and radiation risk communication among radiographers working in clinical practice.	• Further education on radiation benefit-risk communication for radiographers
Aipanda et al.[10] Namibia	Qualitative, primary research 12 radiographers	To explore the experiences of radiographers on risk-benefit communication during CT paediatric imaging	Not indicated	Radiographers had positive experiences with radiation risk-benefit communication, namely, mutual benefit and job satisfaction. Negative experiences resulted in feelings of professional deprecation, ineffectual outcome and communication impediment.	• Developing a radiation risk communication protocol • Use of posters and information aids • Continuous education on radiation benefit-risk communication for radiographers
McAleese et al.[22] Ireland	Quantitative, primary action research 23 radiographers	To implement a communication tool with standardised commands to reduce radiation exposure	Posters	Radiographers believed the communication tool could help reduce radiation exposure.	
Portelli et al.[23] Malta	Quantitative, primary research 100 radiographers	To investigate radiographers' opinions and practice of providing benefit-risk information and seeking consent for paediatric imaging examinations	Active verbal communication	The practice of communicating benefit-risk information to paediatric patients and/or their parents is varied. A possible gap in benefit-risk communication education and/or training was identified, which may impact radiographers' and radiology practitioners' confidence in conveying such information.	• Further education on radiation benefit-risk communication for radiographers

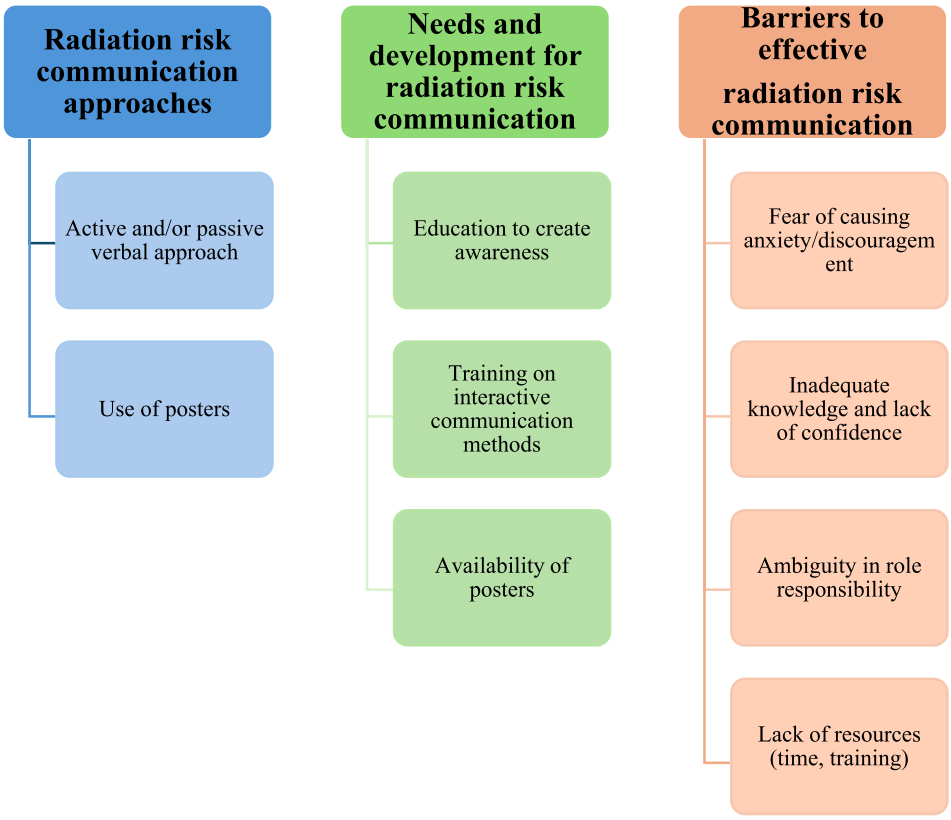

Figure 2. Pictorial representation of thematic findings.

Consistent with broader healthcare risk communication literature,[13,17] the barriers identified in this review suggest that effective communication extends beyond providing factual information and requires attention to patient trust, emotions, perceptions of risk, and individual information needs. To effectively communicate radiation risk, radiographers should understand how patients and their significant others perceive radiation risk and use appropriate strategies to reduce their fears.

One such strategy is to give patients and their parents/guardians a greater sense of autonomy by involving them in the decision-making process.[24] This has been proven to be effective, with a previous study reporting that parents perceive a computed tomography examination ordered by a physician for their children to be of higher risk and thus, less readily accepted by them than those that seem to be under their control.[28] Involving patients and their relatives in the care process will mean radiographers actively presenting them with reasonable alternative imaging modalities. Kasraie et al.[24] assert that this will increase their sense of autonomy because a single imaging option may reduce patients' sense of involvement in their care. As a result, the availability of appropriate alternatives may help reduce X-ray hesitancy. Consistent with literature,[28] this review found the need to explain procedures to patients in simple terms without technical jargons (such as effective dose, size-specific dose estimate, etc) to enhance radiographer-patient communication. In the study by Reitan and Sanderud,[9] one participant emphasised that such terminologies will only lead to misunderstanding and should be avoided.

> *"... I don't think I would have given him the dose information [because] I don't think he would have understood the values. "* (p.87)

Additionally, radiographers may reduce patients' radiation anxieties through strategies that emphasise the benefits of the imaging procedure to the patient. Of note, the purpose of radiography is not to use radiation; instead, the purpose underlying the medical use of radiation is to improve clinical diagnosis and patient care. Since the beneficial aspects are the primary aims of radiography in patient care, Wagner[29] asserts that patient communication during diagnostic imaging procedures should focus on the benefit. Although the "As Low As Reasonably Achievable" (ALARA) concept is useful for radiation protection purposes, several studies have advised against its use when communicating with patients as it is radiation-focused.[24,29,30] (i.e., it highlights the risks of the procedure more than the underlying benefits). Alternatively, radiographers can utilise the educational resources and communication materials provided through the *Image Gently*[31] and *Image Wisely*[32] campaigns which appropriately highlight the benefits of radiological exposures while creating awareness of the potential risks of ionising radiation exposure.[30] Proposed strategies to improve radiation risk communication have been presented in Fig. 3.

Radiographers' inadequate knowledge and limited confidence also limited their ability to explain radiation benefits and risks. This is concerning as it may reduce the effectiveness of the radiographer-patient interaction, potentially resulting in patient dissatisfaction or even diagnostic errors with medicolegal

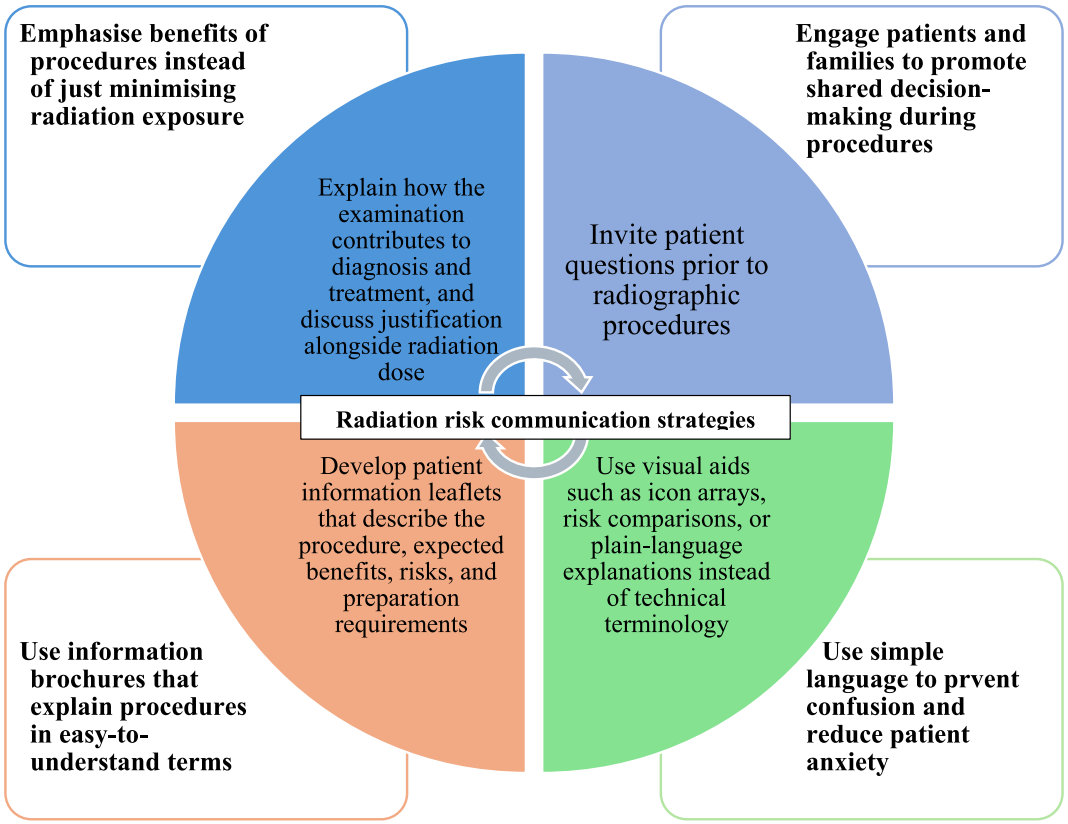

Figure 3. Strategies for improving radiation risk communication in radiography and examples of their implementation in clinical practice. *Note. Outer boxes represent strategies and circle represent practical applications.*

implications[24] and loss of public trust.[33] This may further increase X-ray hesitancy. Moreover, the results mean patients and/or their relatives may not be given adequate information to aid their consent. As previously reported by Kasraie et al.,[24] patients frequently receive inadequate information about the benefits and risks of diagnostic imaging procedures. This may be exacerbated by the role ambiguity regarding who bears the primary responsibility to communicate radiation risks and benefits to patients (i.e., is it the radiographer, radiologist, or referring physician?). Indeed, all three have a role to play[9]; however, the radiographer, has the professional responsibility during the diagnostic imaging procedure[34] to ensure the patient receives adequate information that will enable them make appropriate decision. This essential role of the radiographer may be hindered by limited resources, including time pressures within busy imaging departments and insufficient training in risk communication.[35] These barriers highlight systemic issues in radiation risk communication where the principles of informed consent are not always fully realised. Addressing these challenges requires structured communication frameworks, targeted training, and institutional support to ensure patients receive comprehensive, consistent, and empathetic information about radiation risks.

Moreover, it is important to consider the relationship between radiation risk communication and informed consent. Patient autonomy and shared decision-making are fundamental principles of modern healthcare,[36] and patients should be provided with sufficient information regarding the benefits and risks of proposed examinations to support informed decision-making.[37] However, radiation risks are often omitted or inadequately communicated in clinical practice, even for examinations associated with relatively high radiation doses.[38] This may contribute to the variability in communication practices identified in the present review and highlights the ongoing challenge of balancing adequate risk disclosure with practical clinical considerations.

Theme 3: needs and development for radiation risk communication

The findings of this study further highlight important needs and development for radiation risk communication. One major need identified is the importance of education and training on radiation risk communication for radiographers. Structured education, refresher courses, and workshops could strengthen their competence and improve patient engagement. This study also found that reliance on verbal explanations may be inadequate, especially in patient understanding, as most of the information is technical and abstract. As such, the use of interactive communication methods involving encouraging questions and complementing explanations with written information, posters, or digital resources such as video clips can enhance understanding while reducing anxiety.[39] These strategies could be tailored to patient needs and, as such, will promote shared decision-making and support informed consent. One radiographer in Reitan and Sanderud's study[9] clearly highlighted why this is important:

> *"You must read the patients and their need for information, what kind of information they really want. People are different and you should not give too much information either. Many patients experience that as scary."* (p.87)

As a result, the structured education, workshops, and refresher courses may focus on how radiographers can effectively identify the patient's needs for information and the extent of the

information to be given to reduce their fears. Additionally, the development of standardised radiation risk communication approaches and protocols could reduce inconsistencies across hospitals and provide radiographers with clear frameworks for discussing radiation risks.[40]

Limitations

The limitations of this review lie in the inclusion of only English language studies which limited the inclusion of potentially relevant studies as well as the limited number of eligible studies identified. These may limit the breadth of the evidence available. A further limitation is that, consistent with the scoping review methodology, no formal critical appraisal of study quality was undertaken. The included studies varied considerably in methodology, scope, and sample size. Therefore, findings from this review should be interpreted with caution and complemented by local guidelines and practice recommendations. Moreover, the findings should be treated as a mapping of the available evidence rather than an assessment of the strength of that evidence. Nonetheless, the use of a structured scoping review framework by Arksey and O'Malley[18] and the inclusion of studies from diverse locations helped improve rigour. However, given the limited and heterogenous nature of the available evidence, future research should consider intervention-based studies or a systematic review to evaluate the effectiveness of risk communication interventions in healthcare and explore their applicability to radiography.

Conclusion

Radiographers play an essential role in radiation risk communication, yet current practices remain inconsistent and often inadequate. Even though verbal communication is useful in risk communication, this approach as used by radiographers is frequently unstructured and limited by factors such as time constraints, fear of increasing patient anxiety, inadequate knowledge, and role ambiguity. These compromise patient-centred care and as such, there is the need to improve radiographers' competence and confidence through continuous education and training. Additionally, the verbal communication approach could be complemented with written information, posters, and brochures to enhance patient understanding. The development of standardised protocols and institutional support is also needed to ensure consistent and effective practice. Addressing these gaps will improve justification of radiographic examinations, support informed consent, and enhance patient autonomy, safety, and trust in medical imaging services.

Ethics approval and consent to participate

Not required for narrative reviews.

Availability of data

All data (literature) associated with this work have been cited within the paper.

Author contributions

NAA: Conceptualisation, Methodology (Data extraction and Analysis), Visualisation, Writing – Original Draft; Writing – Reviewing and Editing; **SS**: Methodology (Literature search and Screening), Writing – Reviewing and Editing; **JA**: Methodology (Screening), Writing – Reviewing and Editing; **JLA**: Conceptualisation, Methodology (Literature search, Screening, and Analysis), Visualisation, Writing – Original Draft, Reviewing and Editing.

Generative AI use

The authors confirm that no Generative AI tools were used at any stage in the preparation of this manuscript.

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Conflict of interest statement

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