

# Enhancing Radiology Safety Through Bias Awareness and Human-Factors Learning

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## SUMMARY

Radiology is prone to cognitive bias. High workload, interruptions, pattern-recognition fatigue, and time pressures create situations where anchoring, satisfaction of search, and premature closure can occur. Radiology Events and Learning Meetings (REALMs) provide a forum for sharing discrepancies, but their value depends on psychological safety. Without a blame-free environment, clinicians cannot fully explore how bias influences decisions. This work examines how human-factors-informed REALM adaptations can improve bias awareness, strengthen reflective decision-making, and enhance patient safety.

## KEYWORDS

Radiology, learning, cognitive bias

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## Introduction

Radiology is inherently susceptible to cognitive bias because interpretation relies on rapid pattern recognition under uncertainty, high workload, frequent interruptions and time pressure. Experienced radiologists frequently use intuitive reasoning to manage large volumes of cases efficiently but these heuristic processes are vulnerable to cognitive biases such as anchoring, satisfaction of search, availability bias, confirmation bias, premature closure and automation bias (Croskerry, 2002, Kahneman, 2011). These biases are not evidence of individual failings but they simply reflect human cognition operating within complex systems. Patient safety science emphasises that error arises from interactions between individuals, technology and organisational processes rather than isolated personal failings (Reason, 2000, Dekker, 2014).

Errors and discrepancies in radiology are inevitable. Brady (2017) outlines the evidence that in routine day-to-day practice, 3 to 5% of imaging studies will have a reporting discrepancy, with higher rates observed in more complex examinations. With over 1 billion imaging examinations interpreted around the world each year, this implies that tens of millions of interpretations may be affected annually. From the literature, clinically significant discrepancies often arise from cognitive and system related factors rather than deficient knowledge (Bruno, 2015). These findings highlight the need for structured, reflective processes that illustrate how interpretation occurs in typical reporting conditions and why systematic discussion of cognitive biases is essential for patient safety.

## Radiology Events and Learning meetings and Psychological Safety

Radiology events and learning meetings (REALM) are structured educational forums outlined by the Royal College of Radiologists (RCR, 2021) for sharing of anonymised cases of errors, discrepancies and good spots in a safe blame-free setting. Typically, these meetings are held bimonthly and allow all reporters to reflect on cases, explore system factors that might have influenced interpretation and share learning points. By standardising the review process and

aligning with RCR standards, REALMs provide a safe forum for learning from errors while simultaneously promoting good practice and consistency across UK radiology departments.

Importantly, REALMs are distinct from governance and investigative processes. Cases discussed in REALMs are not used for disciplinary review and the primary goal is reflective learning in a group setting rather than individual accountability. This separation preserves psychological safety which is defined as the shared belief that interpersonal risk taking is safe and this is essential for open discussion (Edmondson, 1999). Framing cognitive bias within this context aligns with patient safety science in that biases are recognised as predictable human tendencies shaped by environment, workload and system design, rather than personal failing (Reason, 2000, Dekker, 2014).

### Human Factors and SHEEP model

While formal models such as SEIPS can support analytical investigation, REALMs intentionally avoid such models to preserve the safe, learning culture. Instead, discussions are guided by structured, reflective questioning informed by the SHEEP framework (Rosenorn-Lanng, 2014). This model breaks down into Systems, Human interactions, Equipment, Environment, Personal factors which provides a practical framework to explore potential interacting influences in a radiology department on reporter performance, without formal incident analysis.

- **Systems** include organisational processes and workload pressures.
- **Human interactions** encompass team working, communication and handovers.
- **Equipment** covers tools workstations, medical equipment and any devices required to fulfil our role.
- **Environment** captures physical workspace and workflow conditions.
- **Personal factors** include hunger, fatigue, stress, cognitive load and any personal circumstance that might be relevant.

SHEEP prompts broad reflection beyond the cognitive processes and reinforces a system level perspective. Rather than mapping each cognitive bias directly into the SHEEP model, we use it as a lens to identify influences that can contribute to error and bias. In busy radiology departments, constant interruptions, noisy workspaces and high flow workflow demands interact with personal and system factors to create very high risk conditions. By asking reflective questions in each domain, reporters can identify potential risks and consider practical mitigations.

### Bias Awareness Prompts

Alongside SHEEP model reflection, we continue to use structured bias awareness prompts to support metacognitive reasoning.

Table 1. Cognitive Bias Awareness Framework for Radiology Reporting

Bias	Definition	Reflective Prompt Questions	Radiology Example
<b>Anchoring</b>	Overreliance on initial impressions	<ul style="list-style-type: none"> <li>• What was my first impression?</li> <li>• Did I seek other evidence of alternative pathology?</li> </ul>	Assuming lymph node enlargement relates to cancer and not thinking of treatable infections, such as TB
<b>Satisfaction of Search</b>	Ceasing search after first abnormality	<ul style="list-style-type: none"> <li>• Did I complete a systematic review after first abnormality?</li> <li>• Could there be additional pathologies?</li> </ul>	Pneumothorax detected but ipsilateral rib fracture missed
<b>Availability Bias</b>	Judgement influenced by recent	<ul style="list-style-type: none"> <li>• Am I influenced by recent similar cases?</li> </ul>	Overcalling rare tumour after seeing a recent case

	memorable cases	<ul style="list-style-type: none"> <li>• How common is this finding in this context?</li> </ul>	
<b>Confirmation Bias</b>	Interpretation shaped by request or expectations	<ul style="list-style-type: none"> <li>• How did the clinical information influence my search?</li> <li>• What would I report if I had not read the request?</li> </ul>	“Rule out pulmonary embolus” request leads to overlooking incidental lung mass
<b>Automation Bias</b>	Overreliance on prior report or AI output	<ul style="list-style-type: none"> <li>• Have I independently verified this finding?</li> <li>• If I had no prior AI report, what would I see?</li> </ul>	Accepting prior AI report of “no acute abnormality” without verification
<b>Premature Closure</b>	Ending reasoning before full review	<ul style="list-style-type: none"> <li>• Have all sequences/views been reviewed?</li> <li>• What diagnosis might be missed?</li> </ul>	Reporting CT before reviewing delayed phase, missing subtle liver lesion

### Reflection in practice

Embedding SHEEP reflection and bias prompts into REALMs allows staff to explore the interaction of systems, processes with environmental and personal factors which might affect interpretation. Peer-level REALMs, including Resident and Reporting Radiographer forums, enhanced psychological safety by reducing hierarchical barriers, enabling open discussion. General larger all reporter REALMs build on this foundation to identify broader system and workflow improvements.

Structured participant feedback was collected using a set of questions designed to evaluate psychological safety and perceived learning impact of REALMs. Participants rated their agreement (1 to 5 Likert scale) with statements including:

1. When I attend REALM, I feel comfortable contributing
2. When I attend REALM, I feel safe to discuss error without blame.
3. When I attend REALM, participating improves my confidence in discussing discrepancies.
4. When I attend REALM, it helps me reflect more deeply on my decision-making.
5. When I attend REALM, the sessions help me apply the learning to my future reporting.
6. When I attend REALM, the discussions help identify workflow or systemic issues.

Across six months, mean scores for all statements exceeded 4/5, supporting there being strong psychological safety and perceived educational value.

### Key Takeaways

**REALMs follow Royal College of Radiologists standards.** Bimonthly departmental meetings present anonymised cases to support safe learning.

**Psychological safety is essential in all REALMs.** Peer level REALMs encourage open dialogue about reasoning, uncertainty and errors whilst reducing hierarchical barriers and increasing confidence in discussing discrepancies.

**Human factors informed REALM supports safer systems and resilient decision-making.** Reflection, structured prompts and psychological safety translate learning into practice and encourage system improvement.

**Reflection on errors must include bias awareness.** Bias vocabulary normalises discussion. Explicitly naming common biases improves awareness and allows practical mitigation strategies to

be developed. Structured prompts and metacognitive questioning help radiologists identify cognitive shortcuts that may contribute to discrepancies.

**Reflection promotes system thinking.** Considering systems, human interactions, equipment, environment and personal factors broadens understanding of all the potential influences on diagnostic performance.

### Discussion and Future Directions

This combination of bias prompts, SHEEP reflection and structured feedback enhances diagnostic resilience and support in a no-blame learning culture. By focusing on systemic and contextual factors, radiologists can proactively identify risk and implement process and system improvements, even in busy, noisy, interruption-prone departments. By continuing to explore common bias scenarios and map interventions to workflow, environmental and system improvements, we can optimise educational output and impact patient safety.

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