Effectiveness of quality improvement interventions for patient safety in radiology: a systematic review protocol

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Review question/objective: The objective of this review is to find the best available evidence regarding effectiveness of quality improvement interventions in clinical radiology and the experiences and perspectives of staff and patients. More specifically, the review questions are:

- How effective are the interventions that may improve or affect patient safety and quality in clinical radiology?
- What are the experiences and perspectives of staff and patients of patient safety and quality improvement interventions?

Keywords: Diagnostic imaging; health information technology; healthcare professional; medical imaging; patient safety

Background

Quality improvement is the term used to describe the combined effort of healthcare professionals, patients, their families, researchers, payers, planners and academics to make changes in three basic fields of health care: better patient outcomes (health), better system performance (care) and better professional development (learning).¹ Patient safety, defined as the decrease of risk of unnecessary harm associated with health care to an acceptable minimum,² is one dimension of the quality of health care.³ Comprehensive quality and practice improvement programs implemented across radiology departments within hospitals have shown some promise in improving quality and patient safety.⁴-⁶ There are, however, comparatively few interventions that are known to improve quality and patient safety in radiology. Additionally, the evidence base to guide quality improvement in radiology is weak.⁷ For example, unlike many medical disciplines and disease-based interest groups, such as “Acute Respiratory Infections”, “Airways”, “Anesthesia” and “Critical and Emergency Care”, there is no Cochrane Review Group for Radiology.⁸

Radiology is heavily reliant on information technology (IT), helping to streamline a wide range of operations and provide safe, effective solutions. Health information technology (HIT) has emerged as an indispensable tool of radiology that has been employed widely in healthcare sectors and endorsed as a remedy to many of the challenges faced by imaging departments. Radiology IT systems such as Picture Archiving and Communication Systems, Radiology Information Systems and Computer-aided diagnosis are used to enhance efficiency, effectiveness and safety.⁹,¹⁰ Although such technology has the potential to provide huge advantages for healthcare delivery and patient outcomes, it can affect patient safety and the quality of care, resulting in patient harm due to inadequate planning, integration, training or testing.¹¹-¹⁴

However, patient safety is difficult to quantify. It may be measured as the number of patient safety events, or “incidents”, which are defined as an event or circumstance, which could have resulted, or did result, in unnecessary harm to a patient.²,¹⁵ Adverse events occur when patients are actually harmed by their health care rather than an underlying disease.² Known types of adverse events in radiology include diagnostic errors¹⁶-¹⁹, transcription errors in radiology reports²⁰,²¹, infections²²,
adverse drug events, wrong site, side, patient or procedure complications, falls, and pressure sores. Patient safety data may be shown through incidents reported by healthcare professionals and/or patients and carers, coroner’s reports, medico-legal case files, medical records from private facility and state-based public hospital.

Awareness of patient safety in radiology has risen over the last decade through analysis of incidents and by focusing on human factors and nontechnical skills (NTS). Human factors are part of the scientific discipline dealing with interactions among humans and other elements of the system that optimize human wellbeing and overall system performance. Nontechnical skills are cognitive, social and personal resource skills that contribute to safe and efficient task performance. They are essential to complement the technical skills possessed by medical engineers, radiographers and radiologists as situation awareness, decision making, communication, teamwork and leadership are incorporated with technical tasks. Communication failure and delayed diagnosis are the most prevalent of these patient safety incident types in radiology.

Adverse events may also occur due to improper human performance or failure to operate radiology HIT, such as incorrectly requesting a study by referrer, lack of rigor in performance by a radiographer or misinterpreting a study by radiologist. Moreover, radiologists may be given minimal training on the use and operation of such systems or more attention and concentration may be required to perform new tasks, interventions and treatments that are often not possible due to heavy workload or deficiency in workforce. Radiology departments are required to address these risks in a timely manner using principles of system resilience and high-reliability organizations.

The risks of adverse events may be overcome by improving understanding of error, ensuring appropriate criteria at the time of entry of patient data, utilizing correct imaging technique, adhering to as low as reasonably achievable, proper integration of new HIT systems, contingency planning and escalation procedures, and configuration and communication between systems. In addition, healthcare providers are urged to improve safety culture, which has been considered as an important precursor for improving deficits in patient safety and thus may be considered as a proxy for patient safety. Safety culture has been measured using a number of tools such as the Safety Attitudes Questionnaire (SAQ) or Hospital Survey on Patient Safety Culture (HSOPSC).

Interventions to improve patient safety in radiology have focused on several other areas. For example, the implementation of new technologies addressing human factors and systems deficits, including technologies like patient identification, voice recognition and web-based solutions. Moreover, there has also been a demand for general improvement in patient safety in radiology focusing on various interventions such as learning from error, using incident reporting systems, safety rounds, awareness and cognitive behavior, clinical audit, clinical governance, teamwork and communication. A few studies have also shown that the use of a pre-procedural checklist or surgical safety checklist in radiology improves communication and teamwork and reduces adverse events.

However, critics of patient safety interventions, such as those discussed previously, often claim that they negatively impact on throughput of patients or clinician workflow. A clearer understanding of the possible negative impacts of patient safety interventions is required, and therefore, patient throughput in radiology departments, and/or radiologist workflow, will be included as secondary outcomes in this systematic review. In addition, the success of patient safety interventions is dependent on clinician engagement, therefore, knowing clinicians’ perceptions and experiences of the intervention is essential to understanding why an intervention has or has not worked. The use of both qualitative and quantitative methods in patient safety research is proposed to contextualize results. Consequently, this systematic review will also include the qualitative experiences and perceptions of staff and patients.

The majority of previously cited studies examining interventions for improving patient safety in radiology are of low quality and/or use a study design that is prone to bias. To date, no comprehensive systematic review has been identified that appraises quality improvement interventions in radiology. The initial search looking for such systematic reviews or systematic review protocols was...
conducted by the author during March 2015. Key search terms utilized for this initial search included radiology, medical imaging, patient safety, safety and quality, and patient safety intervention. The databases such as Cochrane Library, PROSPERO and the JBI Database of Systematic Reviews and Implementation Reports were searched accordingly. Published reviews have addressed patient perspective of receiving care in medical imaging or radiology; however, there is an absence of reviews on quality improvement interventions. The proposed systematic review will provide comprehensive evidence of quality improvement interventions in radiology practice.

**Inclusion criteria**

**Types of participants**
The quantitative and qualitative components of this review will consider studies that include patients undergoing radiological examinations and/or healthcare professionals (radiologists, radiographers, medical imaging nurses and other personnel) working in hospitals or stand-alone healthcare facilities or “super-clinics”. “Super clinics” are healthcare services with integrated multidisciplinary patient care center, often including a general practitioner, a provider of radiology and other allied health providers.

**Types of intervention(s)**
The current review will evaluate the following types of quality improvement interventions: human factors, HIT, training and education, staffing arrangements (staffing levels, skill mix, grade mix and qualification mix), regulation, incident reporting and management, peer review (re-validation), clinical audit, teamwork and communication interventions (e.g. TeamSTEPPS), safety checklists, local (clinical) governance and any other intervention that meets the definition of quality improvement interventions. Interventions that test the diagnostic accuracy or performance of particular imaging modalities or interventional radiology procedures will be excluded from the review.

**Phenomena of interest**
For the qualitative component of the review, the phenomena of interest are the experiences and perspectives of staff and patients undergoing, or being exposed to, the quality improvement intervention. These experiences or perspectives could include descriptions of safety concerns, the context and culture of the workplace (including factors such as conflict and how it is managed, teamwork behaviors or the attitudes of staff to patient safety), the management of adverse events and near misses or changes to work practices. It is anticipated that this data would be obtained from interviews and/or focus groups with staff or patients and, potentially, participant observations.

**Context**
The current systematic review will consider studies that are based on a radiological setting.

**Outcomes**
The quantitative component of this review will consider studies of “patient safety” outcomes including adverse events and near misses (incidents), and any validated quantitative measurement of safety culture (such as the SAQ or HSOPSC tools).

The review will also include a number of secondary outcomes. The first group of secondary outcomes will be NTS including situation awareness, decision making, communication, teamwork, leadership, managing stress and coping with fatigue. Outcomes of NTS will be measured on the basis of healthcare personnel’s command, control ability, competence, simulation-based training, real-time ratings, adaptability to healthcare settings and others.

Both patient throughput and clinician workflow, objectively measured in terms of number of patients treated in a defined time period by a defined number of staff, will also be included as secondary outcomes. The final secondary outcome will be radiology patient satisfaction, which provides patients’ perspective on the quality of care.

**Types of studies**
The quantitative component of this review will consider Randomized Controlled Trials (RCTs) or Cluster Randomized Controlled trials (CRCTs). In the absence of RCTs or CRCTs, other experimental study designs including non-randomized controlled trials, quasi-experimental, controlled before after trials and interrupted time series trials will also be considered for inclusion.

The qualitative component of the review will consider interpretive studies that focus on qualitative
data including, but not limited to, designs such as phenomenology, grounded theory and ethnography. Mixed methods and descriptive studies will also be included.

Search strategy
The search strategy aims to find published and unpublished studies. A three-step search strategy will be utilized in this review. An initial limited search of EMBASE and MEDLINE (via Ovid) will be undertaken followed by analysis of the text words contained in the title and abstract, and of the index terms used to describe article. A second search using all identified keywords and index terms will then be undertaken across all included databases. Third, the reference list of all identified reports and articles will be searched for additional studies. Studies published in English will be considered for inclusion in this review. Studies published from 1990 (when the first substantive patient safety research study, “Harvard Medical Practice”, was published) onward will be considered for inclusion in this review.

There is little published evidence on interventions to improve patient safety in radiology. Therefore, we have decided to keep the search broad and focus on different types of interventions that have been implemented with the intention of improving patient safety as primary outcome and other secondary outcomes as mentioned above.

The databases for published studies to be searched include EMBASE, MEDLINE, CINAHL, Cochrane Central Register of Controlled Trials, PsycINFO and Web of Science. The search for unpublished studies will include Mednar, Trove, Google Grey and OCLC WorldCat Dissertations and Theses.

Initial keywords to be used will be:
Radiology and its modalities: Radiology, diagnostic imaging, medical imaging, clinical radiology, X-rays, computed tomography, angiography, mammography, magnetic resonance imaging, ultrasound, positron emission tomography, single photon emission computed tomography (Using OR Boolean operator).


Interventions: Health information technology, picture archiving communication system, radiology information system, computer aided diagnosis, voice recognition technology, human factors, ergonomics, human engineering, training, education, staffing arrangement, incident reporting, peer review, clinical audit, teamwork intervention, communication intervention, team training, safety checklist, local governance, quality improvement intervention (using OR Boolean operator).

Outcomes: Patient safety, incident, sentinel event, event, near miss, adverse event, adverse incident, safety incident, patient safety incident, event register, safety culture, non-technical skills, patient throughput, workflow, patient experience, patients perspective, staff experience, staff perspective (using OR Boolean operator).


Assessment of methodological quality
Quantitative papers selected for retrieval will be assessed by two independent reviewers for methodological validity prior to inclusion in the review using standardized critical appraisal instruments from the Joanna Briggs Institute Meta Analysis of Statistics Assessment and Review Instrument (JBI-MAStARI) (Appendix I). Any disagreements that arise between the reviewers will be resolved through discussion or with other reviewers.

Qualitative papers selected for retrieval will be assessed by two independent reviewers for methodological validity prior to inclusion in the review using standardized critical appraisal instruments from the Joanna Briggs Institute Qualitative Assessment and Review Instrument (JBI-QARI) (Appendix II). Any disagreements that arise between the reviewers will be resolved through discussion or with other reviewers.

Critical appraisal will be conducted on these papers. All papers will be included in the review.
Where possible, sensitivity analysis will be conducted to determine if methodological quality impacts on the results of meta-analysis. The results of higher quality papers (in which a score of 80% or more is achieved in critical appraisal) will be compared with lower quality papers (a score of less than 80% in critical appraisal).

Data extraction
Quantitative data will be extracted from papers included in the review using the standardized data extraction tool from JBI-MAStARI (Appendix III). The data extracted will include specific details about the interventions, populations, study methods and outcomes of significance to the review question and specific objectives.

Qualitative data will be extracted from papers included in the review using the standardized data extraction tool from JBI-QARI (Appendix IV). The data extracted will include specific details about the interventions, populations, study methods and outcomes of significance to the review question and specific objectives.

Data synthesis
Quantitative papers will, where possible, be pooled in statistical meta-analysis using JBI-MAStARI. All results will be subject to double data entry. Effect sizes expressed as odds ratio (for categorical data) and weighted mean differences (for continuous data) and their 95% confidence intervals will be calculated for analysis. Heterogeneity will be assessed statistically using the standard Chi-square and I²-square. Heterogeneity will also be explored using subgroup analyses based on the different quantitative study designs included in this review. Where statistical pooling is not possible, the findings will be presented in narrative form including tables and figures to aid in data presentation where appropriate.

Qualitative research findings will, where possible, be pooled using JBI-QARI. This will involve the aggregation or synthesis of findings to generate a set of statements that represent that aggregation, through assembling the findings rated according to their quality, and categorizing these findings on the basis of similarity in meaning. These categories are then subjected to a meta-synthesis to produce a single comprehensive set of synthesized findings that can be used as a basis for evidence-based practice. Where textual pooling is not possible, the findings will be presented in narrative form.

Acknowledgements
The current review will contribute toward a PhD degree from the University of South Australia for the main author (SRJ).

References


Appendix I: MASTARI critical appraisal instrument

### JBI Critical Appraisal Checklist for Randomised Control / Pseudo-randomised Trial

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
<th>Unclear</th>
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<td>1. Was the assignment to treatment groups truly random?</td>
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<td>2. Were participants blinded to treatment allocation?</td>
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<td>3. Was allocation to treatment groups concealed from the allocator?</td>
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<td>4. Were the outcomes of people who withdrew described and included in the analysis?</td>
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<td>5. Were those assessing outcomes blind to the treatment allocation?</td>
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<td>6. Were the control and treatment groups comparable at entry?</td>
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<td>7. Were groups treated identically other than for the named interventions</td>
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<td>8. Were outcomes measured in the same way for all groups?</td>
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<td>9. Were outcomes measured in a reliable way?</td>
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<td>10. Was appropriate statistical analysis used?</td>
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Overall appraisal: [ ] Include [ ] Exclude [ ] Seek further info. [ ]

Comments (Including reason for exclusion)
Appendix II: QARI appraisal instrument

**JBI QARI Critical Appraisal Checklist for Interpretive & Critical Research**

<table>
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<th>Question</th>
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<tr>
<td>1. Is there congruity between the stated philosophical perspective and the research methodology?</td>
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<td>3. Is there congruity between the research methodology and the methods used to collect data?</td>
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<td>4. Is there congruity between the research methodology and the representation and analysis of data?</td>
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<td>5. Is there congruity between the research methodology and the interpretation of results?</td>
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<td>6. Is there a statement locating the researcher culturally or theoretically?</td>
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<td>7. Is the influence of the researcher on the research, and vice versa, addressed?</td>
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<td>8. Are participants, and their voices, adequately represented?</td>
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<td>9. Is the research ethical according to current criteria or, for recent studies, is there evidence of ethical approval by an appropriate body?</td>
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<td>10. Do the conclusions drawn in the research report flow from the analysis, or interpretation, of the data?</td>
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**Overall appraisal:** □ Include □ Exclude □ Seek further info. □

Comments (Including reason for exclusion)
Appendix III: MAStARI data extraction instrument

**JBI Data Extraction Form for Experimental / Observational Studies**

Reviewer ____________________ Date ____________________
Author ____________________ Year ____________________
Journal ____________________ Record Number ____________________

**Study Method**
- RCT
- Quasi-RCT
- Longitudinal
- Retrospective
- Observational
- Other

**Participants**
- Setting
- Population

**Sample size**
- Group A ____________________ Group B ____________________

**Interventions**
- Intervention A

- Intervention B

Authors Conclusions:

Reviewers Conclusions:
### Study results

#### Dichotomous data

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#### Continuous data

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Appendix IV: QARI data extraction instrument

**JBI QARI Data Extraction Form for Interpretive & Critical Research**

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<td>Year</td>
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<td>Journal</td>
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**Study Description**

Methodology

Method

Phenomena of interest

Setting

Geographical

Cultural

Participants

Data analysis

Authors Conclusions

Comments

Complete    Yes ☐    No ☐
## SYSTEMATIC REVIEW PROTOCOL

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Extraction of findings complete: Yes ☐ No ☐