Radiology Written Report Guideline Project

*Full guideline document for public consultation*

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PROJECT OWNERS
The Royal Australian and New Zealand College of Radiologists (RANZCR)

Auspice: RANZCR

Project managed under the RANZCR's Quality Research and Development Program

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GUIDELINE DESCRIPTION

What is the guideline for?
This is a clinical practice guideline for the written radiology report for the Royal Australian and New Zealand College of Radiologists (RANZCR). Guideline development has been achieved by a multidisciplinary team, using a transparent and documented process of integration of evidence with expert opinion.

Who is the guideline for?
The guideline is intended for use by radiologists. It aims to highlight good practice points that should improve the quality of written communication by the radiologist about imaging procedures.

The guideline recommendations will be suitable for dissemination and implementation through the RANZCR's Standards of Practice for Diagnostic and Interventional Radiology and through the new RANZCR Radiodiagnosis Training Program.

Why was the guideline developed?
The RANZCR currently has no guideline or specific training relating to the written report.

The written radiology report is the dominant method by which radiologists communicate their interpretation of imaging findings. The quality of the report, therefore, has a direct impact on the safety and appropriateness of decisions about treatment and further investigations. The written report may also be used in education or research, serve as a legal document and/or provide billing information.

Several clinical practice guidelines and a number of publications in the radiology literature have considered the style, content, timeliness, and clarity of the written radiology report and how it might be improved.

The guideline development process
The RANZCR has acknowledged the need for a guideline that is applicable to Australian and New Zealand practice, is as evidence-based as possible and that takes into account the views of consumers, the referring community, and providers of radiology reports in the public and private sector. Rather than adopting guidelines developed by other radiology professional bodies, a decision was made by RANZCR that

- an up-to-date literature review,
- general practitioner and provider on-line survey, and
a transparent multidisciplinary consensus process

should take place to inform the development of a new guideline for use by Fellows and trainees of the College.

This process began in July 2008 with a grant from the Commonwealth Department of Health and Ageing to fund a literature review and Practitioner Survey that were carried out under the auspices of RANZCR’s Quality Use of Diagnostic Imaging Program.

LITERATURE REVIEW

The aims of the literature review were to:

1) Identify the evidence relating form and content of the written radiology report to objective or subjective measures of quality (such as clarity, utility, comprehensiveness and extent to which the report addresses the key question(s) posed in the clinical notes provided in the referral for imaging).

2) To determine gaps in the evidence that could be filled by further research.

This review has subsequently been published in the August 2010 issue of the Journal of the American College of Radiology and the review including tables is appended (Appendix 2).

This literature review and associated evidence tables have supported the development of the current guideline and is the only published systematic attempt to bring together studies relating to the form and content of the written radiology report. The review addresses the following issues relating to a literature review supporting guideline development that are prescribed by the National Health and Medical Research Council (NHMRC) standards and procedures for third party development of clinical practice guidelines:

- The criteria used to select studies for inclusion and exclusion for appraisal are described.
- Systematic searches for evidence are undertaken and described.
- The dates covered by the searches are included.
- The tools used to critically appraise the included studies are explicitly stated.
- Completed critical appraisal documents are retained.
- The strengths and limits of the body of evidence reviewed are described in the text.
- Search strategies for each clinical question are available as an appendix to the full guideline.
- The systematic searches include consumers’ perceptions and experiences (consumers in this case meaning a health practitioner or radiologist who reads the written radiology report).

PRACTITIONER SURVEY

(See Appendix 1 for detailed report)

Objectives:

The purpose of this survey was to measure subjective characteristics of written reports generated by radiologists and intended for general practitioners (GPs) with regard to:
• **Clarity**: Is it clear what the radiologist thinks the diagnosis(es) is or is not based on the written report?

• **Quality**: How satisfied overall are you with this report? and

• **Action**: Would this report make you decide to do something in relation to treatment or further testing (either immediately or as soon as possible) that you would have not done without the report?

A secondary objective was to compare the responses for these three domains between radiologists and GPs.

Key results:

The report version containing a combination of unambiguous language and a clear recommendation for clinical action and/or further investigation was strongly preferred over other report styles. The association was strongest for the scenario involving brain MRI (OR 19.178 p < 0.001, 95% CI 4.799 to 76.649).

Ratings for overall quality and clinical action also scored the combination of unambiguity and specific recommendation most highly (quality: OR 7.4, p < 0.001, 95% CI: 4.396–12.496; action: 6.7, p < 0.001, 95% CI: 2.950–15.346).

The report containing itemised rather than prose style combined with integration of prior imaging information (but lacking specific recommendation and unambiguity) scored lowest relative to baseline (OR 5.1, p < 0.01, 95% CI: 2.973–8.740 and OR 0.7, 95% CI 0.4–1.2, respectively) with regard to clarity.

**GUIDELINE MULTIDISCIPLINARY PANEL COMPOSITION AND GOVERNANCE**

A guideline panel was convened in March 2010 to provide multidisciplinary (MD) professional and consumer input into the guideline development process. An initial meeting was held in July 2010, with the face-to-face one-day consensus meeting held in September 2010.

**Methods for convening the MD panel**

The skills required for the panel as a whole encompassed expertise in the following:

• clinical knowledge in the topic area;
• personal experience with guideline use;
• retrieval of evidence from the medical literature;
• guideline development and critical appraisal;
• managerial and facilitation skills;
• implementation expertise; and
• policy and administration.

**Specific stakeholder representation**

It was considered important that referrers for diagnostic imaging with diverse clinical interests, as well as radiologists and consumers, were represented. Participants were sent a one-page letter of invitation by the Chair of the Advisory Panel and asked to participate in a panel to develop a guideline for RANZCR regarding the written radiology report. Some of the invitees were known
personally to the Chair and others were invited based on a purported skill set and their interest in the issue.

**Advisory Panel members:**

*(See Appendix 4 for full list of members)*

1. Chair
2. Content expert
3. Consumer representative
4. Private practice (non-corporatised) radiologist
5. Public sector radiologist
6. Chief Censor and Chair, Curriculum Advisory Committee, RANZCR
7. Corporate Radiology representative
8. Referrer – General Practice
9. Referrer – Radiation Oncology
10. Referrer – Emergency Medicine
11. Referrer – Orthopaedic Surgeon
12. Referrer – Paediatric Neurologist
13. Referrer – Gastroenterologist
14. DoHA representative
15. Guideline development expert/Facilitator

The Advisory Panel was supported by project management and a secretariat in the management of meeting arrangements; distribution of documents; production of guideline drafts; and publication/communication/dissemination of the final document.

- Copy editor
  (Freelance)
- Project Management:
  Director, Quality and Standards of Practice, RANZCR
- Communication:
  Director, Communications and Membership, RANZCR
- RANZCR Standards of Practice:
  Manager, Quality and Accreditation, RANZCR

**Conflict of interest declaration**

All participants were asked to declare real or potential conflicts of interest, not as a reason for excluding them from the Advisory Panel, but for other panellists to be aware of any potential biases they might bring to the development of recommendations. Panellists were asked to complete the declaration *(Appendix 3)* that was circulated to all panellists.
METHODOLOGY FOR GUIDELINE DEVELOPMENT

The current guideline departs from typical clinical practice guidelines in that it is not concerned with the formulation of recommendations about the prevention, diagnosis or management of illness in individuals or groups of people. It relates to the suggested form and content of a written document.

For this reason, no single guideline or checklist that has been developed for the purpose of assisting clinicians with the development of clinical practice guidelines could be used in its entirety to inform the methods of guideline development used here.

Thus, a number of documents were used to inform the methods used to develop the recommendations in the guideline and these include:

1) NHMRC standards and procedures for third party development of clinical practice guidelines\(^1\) and the Draft NHMRC Requirements for Approval of Evidence-based Clinical Practice Guidelines\(^2\).


3) ADAPTE Resource Toolkit for Guideline Adaptation Version 1.0\(^3\).

In addition to these documents, face-to-face and telephone meetings regarding guideline development methodology, and in particular the transparent integration of expert panellists’ opinion with evidence, were held with Kay Currie, NHMRC Guidelines Research Group and Tari Turner, Senior Research Fellow, National Trauma Research Institute, Monash University

Scope and purpose

This was determined in part by the available funding ($200,000) and time (18 months) for the guideline development and publication/dissemination process. The Chair of the Advisory Panel determined the following scope and purpose of the guideline and this was agreed on by the funding body (DoHA).

- To develop an evidence- and consensus-based document to guide radiologists and trainees in the creation of a written radiology report in order to maximise its value as a communication tool for other health professionals.

- To provide recommendations on report form and content including:
  - standard and optional fields for radiology reports; and
  - advice on content, format and language.

- To provide an example of a ‘best practice’ radiology report incorporating the aforementioned recommendations (see Appendix 5).

- Specifically excluded from consideration in this guideline are recommendations about the nature of critical findings that should trigger urgent verbal communication between the

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\(^2\) Currently under public consultation, document available on request.

\(^3\) available from www.adapte.org
radiologist and referring clinician. This was outside of the scope of the systematic review of the literature and a literature review on this topic was underway at the time of guideline development.

Advisory Panel – initial meeting

Following determination of the guideline scope and purpose, and convening of the Advisory Panel, an initial teleconference was held on 17 June 2010 with the following aims:

1. Explanation of scope and purpose of guideline.
2. Declaration of conflict of interest of all Advisory Panel members.
3. Role definition of panellists.
   - Panel members represent themselves, not an organisation.
   - Panellists provide:
     - specialist expertise in their own area as referrers, providers or consumers of diagnostic imaging or guideline development/content expertise; and
     - practical clinical perspective to the guideline recommendation development process.

Panellists, in general, were not required to review or appraise evidence in any detail. However, the systematic review (SR), survey report and the individual studies, as well as clinical practice guidelines that were included in the SR, were provided in a web-based database that was password protected. These documents were accessible to panellists at any time during the guideline development process. Although this departs from the usual practice of guideline panellists being required to appraise the available evidence before contributing to formulation of recommendations, this departure was considered appropriate for this particular guideline for the following reasons:

A. The type of evidence found relating to the topic ‘What are the factors that influence quality of the written radiology report?’ was low level and consisted mainly of survey and audit studies with very few interrupted time series (before and after) intervention studies and only one randomised controlled trial. This made it more difficult to meaningfully appraise the available literature on this topic than if the relevant literature consisted of conventional randomised controlled clinical trial studies or diagnostic efficacy studies. The SR addressed the survey size, surveyed group, response rates and potential generalisability of survey findings in the evidence tables provided (Appendix 1, Table IV)

B. The clinical practice guidelines on this topic were appraised by Dr Felicity Pool using the AGREE tool and this appraisal was included in the systematic review. In general, the guidelines were not found to link evidence with their recommendations, nor did they document whether a literature search was undertaken before the recommendations being developed. The guidelines were mainly used to assist with development of the domains to be addressed in this guideline rather than as a source of recommendations (Appendix 2, Table III).

4. Consensus process – How will the Advisory Panel manage development of the guideline recommendations?
• Recommendations will be based around headings arising from other guidelines and key themes in literature review (see next section).

• Evidence will inform guidelines, and the type of evidence from which the recommendation is derived will be clearly stated.

• It will be made clear where a recommendation is based on consensus.

• If consensus cannot be reached face-to-face, a confidential ballot will take place out of session and the result provided to the Advisory Panel for consideration in developing the final draft recommendation.

5. Information about document website.


• All panellists will be named as participating in the development of the draft guideline.

7. Potential endorsement bodies of the final guideline.

• The draft guideline will be provided to the RANZCR Council for endorsement by the Royal Australian and New Zealand College of Radiologists.

8. Role of the Advisory Panel in dissemination and implementation strategies.

• Because panellists are representing themselves rather than an organisation, it is not envisaged that they will have a significant role in the implementation or dissemination of the guideline.

• Guideline dissemination and implementation via educational programs and curriculum development will be the primary responsibility of RANZCR.


Advisory Panel – full day recommendation consensus meeting

The Advisory Panel met in Melbourne on 17 September 2010 to reach consensus on draft guideline recommendations.

In addition to reaching consensus on amendments to both the ‘Comments’ and ‘Recommendations’ components of the guideline, the Panel agreed to reordering, renumbering and combining of some sections of the guideline.
GUIDELINES FOR THE WRITTEN RADIOLOGY REPORT

REPORT CONTENT

1. History/clinical information

Evidence: A statement of the clinical information available to the radiologist at the time the report was created was recommended in 3/4 guidelines (2, 4, 5) and 1/3 surveys (28). This information was missing from a significant proportion of written reports in 1/2 audits (28).

Comment
Written documentation by the radiologist of all relevant information that was available at the time of the interpretation of images or carrying out of an interventional procedure provides the context for image interpretation. Because of the nature of radiological practice, it may not be efficient or even feasible for this information to be documented in any other way, such as in the written or electronic patient medical records used by the referrer or hospital. The written radiology report is not just for the referrer, but also may be read by other clinicians who provide health care services to the patient and by other radiologists interpreting subsequent imaging studies.

Accurate documentation of the clinical context of the referral can have medico-legal and risk management implications for the radiologist, the patient and the imaging facility/hospital.

It is important to state the source of the clinical information if it was not on the written referral.

Recommendation(s):
A summary of the relevant clinical information provided, and its interpretation by the radiologist, should be included in the written report.

The source(s) of this information should be clearly stated if this was not the written referral.

2. Comparison with prior studies

Evidence: A comparison with previous study(ies) was advised in 2/4 guidelines (2, 3) and was important in 2/2 surveys (22, 28), but this item was frequently omitted from reports in 2/3 audits (16, 28). The practitioner survey (Appendix 1) commissioned by RANZCR in 2008 found that incorporation of information from prior studies was less important to both radiologists and general practitioners in contributing to report quality than were lack of ambiguous terminology and presence of specific recommendations at the end of the report.

Comment
It is recognised that unavailability of prior relevant imaging at the time of reporting, even if such imaging exists, can have an important impact on interpretation and recommendations made by the radiologist. Inability to review prior imaging in conjunction with the current imaging and/or failure of incorporation of this review/comparison into the written report can have important consequences.
Recommendation(s):
A specific statement should be made about the existence and availability for review of previous imaging relevant to the current examination.

3. Technique

All important/relevant information about the technique should be documented.

A. Technical details

Evidence: Technical details were recommended in 3/4 guidelines, with the provision that this may be instead documented elsewhere in the medical record (2, 3, 5). Technical information was valued in 1/3 surveys (28), but not by primary care practitioners in another 1/3 surveys (21). Technical data were incomplete in reports assessed by 1/3 audits. Contrast information, including documentation of consent but not the issues discussed, was important in 1/3 surveys (28), but disliked by primary care practitioners in 1/3 surveys (21). 1/1 Survey respondents specifically wanted contrast and other reactions to be documented in the report (26).

Comment

Routine examination technical details include imaging parameters, for instance MR sequences and CT dose, and contrast or other medication administered during the study. Much of this information may also be documented in other permanent records.

Recommendation(s):
The examination technique should be documented. This should include:

- nature and type of contrast agent(s) and route(s) of administration; and
- nature and type of any adverse reaction(s) to contrast media and how this was treated.

B. Procedural description

Evidence: 3/4 Guidelines (2, 3, 5) recommended description of materials and procedures.

Examples include, but are not limited to:

- Biopsy/drainage procedures: precise description of the location of the lesion/collection, needle/drain tube size, number of passes of the needle, nature of aspirated/biopsied material and submission of any aspirated or biopsied material for analysis.
- Angiography/intervention: puncture site(s), nature of the procedure and puncture site haemostasis/use of vascular closure devices.
- Therapeutic injections: imaging guidance used, needle size, structure injected (e.g. joint, tendon sheath or anatomical space) and composition of injected material.
Comment
Development of standard materials (electronic, paper based, or both) to support documentation of procedures themselves, as well as post-procedure care can contribute to the efficiency of written procedural documentation in the report. These materials, rather than their detailed content, can be referred to in the written report, provided that the version of the standard information that was current at the time of report writing can be accessed at a later date.

Note: For some tumour types (e.g. sarcoma), it can be critical to state (and record) the course of the biopsy needle through other structures (as the needle track is generally excised at the time of surgical treatment)

Recommendation(s):
- All relevant procedure-related information should be provided – any immediate or delayed procedural complications and how these were managed should be described.

4. Examination quality
Evidence: A statement about overall examination quality and limitations was considered important in 2/4 guidelines (2, 3), and was a preference in 5/5 surveys (21, 22, 26, 28, 29).

Comment
It is assumed that when a written report is generated about an imaging procedure that a valid interpretation can be rendered based on the available information, unless otherwise stated by the radiologist.

Examples of factors that can negatively impair image quality:
- lack of contrast administration (oral or intravascular) when this would be the usual procedure;
- patient movement; and
- poor penetration of soft tissues on a plain radiograph due to patient size or exposure factors.

Recommendation(s):
If the overall examination is not good quality, the nature of the limitations should be stated and how these limitations could adversely affect interpretation should be explained.
5. Findings

Evidence: A description of findings in general was prescribed in 4/4 guidelines (2–5) and valued in 2/2 surveys (22, 26). Many papers differentiated between the description of normal and abnormal findings.

i) Abnormal:
   Precise anatomic localisation was frequently omitted in reports in 1/2 audits (13). Anatomic specificity was significantly associated with logical report order, succinctness and conclusions containing significant diagnoses based on the description. Reports were more likely to be in error when they contained statements with low anatomic specificity (p < 0.001) (12).

   Imaging characteristics, such as lesion shape and margins, were not fully described in a significant number of reports in 2/2 audits (11, 13). Examples include attenuation, signal characteristics, enhancement pattern, blood flow characteristics and so on.

   Measurements of significant incidental abnormalities were valued by radiologists and clinicians in 1/1 surveys (28).

ii) Normal
   Review of imaged regional anatomical structures was incomplete in a high proportion of reports in 1/1 audit (16). ‘Pertinent negatives’ relating to an abnormal finding were considered important in 2/3 surveys (24, 28), particularly for non-radiologists (24), and this item was omitted from a significant number of reports in 1/1 audit (28).

Comment

Imaging findings of relevance are not always pathological observations, but may include description of normal progress or measurements (e.g. pregnancy imaging).

Recommendation(s):

Relevant imaging findings should be characterised as specifically as possible including description of:

- precise anatomical location using accepted modality – specific best practice;
- size or extent;
- shape, where relevant; and
- other anatomical/pathological characteristics relevant to diagnosis or treatment.

Normal findings should be noted when:

- the absence of abnormality has direct bearing on diagnosis or subsequent management;
- the absence of abnormality is part of the recognised staging of the severity of a disease process;
- the report takes the form of an itemised checklist, and omission of a specific statement about the normality or abnormality of a standard item can create ambiguity of meaning; and
- the clinical situation of the patient suggests that certain relevant negative information would be useful to the referrer.
6. **Addressing the clinical question**

A. **Answering the clinical question**

*Evidence:* Clinical correlation and/or answering the clinical question was recommended in 2/4 guidelines (2, 3) and was important in 3/3 surveys (19, 22, 26).

**Recommendation(s):**

Specific clinical questions asked by the referrer should be addressed wherever possible in the conclusion of the report.

When it is not possible to answer these specific clinical questions, the reason(s) for this should be clearly stated.

B. **Diagnosis/differential diagnosis**

*Evidence:*

- A pathophysiologic diagnosis, where applicable, was considered important in 2/4 guidelines (2, 3) and in 1/1 survey (22).
- Differential diagnoses were advocated ‘when appropriate’ by 2/4 guidelines (2, 3), and were valued in 1/2 surveys (22).
- Defined by the extent of agreement by readers about whether reports supported a diagnosis of pneumonia, clarity was positively associated with interpretiveness, ie pathological specificity of the report, (OR = 5.597), and negatively associated with lower interpretiveness (OR = 0.188).

*Comment*

Interpretation of the imaging observations and the confidence of the diagnosis should be made – balancing the need to be confident in the finding while at the same time recognising uncertainty.

Interpretation of imaging findings should suggest the presence or absence of a particular pathophysiologic diagnosis or a limited range of diagnoses and/or should assist in managing patients with known conditions.

Reports are clearer when the probability of specific diagnoses being present or absent is conveyed confidently; however, this needs to be balanced against the uncertainty inherent in image interpretation and diagnostic medicine in general.

**Recommendation(s):**

A specific diagnosis(es) for the observed imaging findings should be provided whenever possible. When a number of possibilities exist, these should be stated and their relative likelihood should be described.
7. Conclusion/opinion/impression

Evidence: Conclusion/opinion/impression comprises various elements according to different authors. A diagnosis was required by 4/4 guidelines (2–5). However, 2/4 guidelines modified this recommendation for brief reports (2) or stable comparisons with recent imaging (3); 3/4 surveys indicated a preference of respondents for reports containing a conclusion (21, 28, 29). 1/1 Survey respondents felt that a separate conclusion should only contain significant diagnoses based on previous description in the report body (12). Other ‘conclusion’ components recommended by individual guidelines were correlation with clinical factors (4), specific recommendations (2) and documentation of any adverse reactions related to the procedure (2), and this was also considered important in one of the surveys (26). The conclusion was not clearly defined in a significant proportion of reports in 2/5 audits (11, 28). The quality of the conclusion was subjectively improved by editing (7).

Comment

The conclusion should not introduce new observations or simply be a reiteration of material in the body of the report. It should be an interpretation of the finding(s) in the clinical context.

Recommendation(s):
The conclusion should provide a concise, clinically contextualised interpretation of the previously described imaging observations.

8. Recommendations (for further testing, treatment, referral etc)

Evidence: Recommendations, particularly for further imaging and other investigations, were advocated by 3/4 guidelines (2, 3, 5) and were valued in 6/6 surveys (19, 21, 22, 26, 28, 29), but they were frequently omitted in reports evaluated by 1/3 audits (28). Primary care practitioners were most supportive of recommendations for referral and treatment (21). Respondents to the single survey addressing this issue said they ‘might be compelled to follow an explicitly worded recommendation’ (6). The RANZCR-commissioned radiologist and practitioner survey in 2008 indicated a strong association of a specific recommendation with subjective perceptions of quality and likelihood of changed clinical action.

Comment

Additional imaging or other investigation that is, in the opinion of the radiologist, unlikely to refine the range of diagnostic possibilities, reorder a list of differential diagnoses in a clinically important way or improve patient outcome should not be recommended.

In some situations, the recommendations may be critical to the management of the patient
Examples of this include:

- recommendation of lumbar puncture to exclude subarachnoid haemorrhage in the setting of normal CT scanning and sudden onset of severe headache; and
- recommendation of beta HCG assay in a woman with a positive pregnancy test, abdominal pain and PV bleeding referred for transvaginal ultrasound when no gestational sac is found in the uterus.

**Recommendation(s):**
If further imaging, investigations, referral or treatment is to be suggested, the report should describe:

- how it is expected that this will contribute to the diagnosis and/or management of the patient’s current medical problem;
- the exact nature of the further investigation/referral/treatment that is recommended; and
- the suggested timing of this further investigation/referral/treatment if relevant, especially if this is urgent.
FORMAT OF REPORT AND STYLE OF EXPRESSION

1. Format

A. Length

Evidence: Brevity was considered important in 1/3 surveys (22). Resident reports were longer than staff reports (8) and succinctness was improved by editing (p < 0.007) (7).

Comment

A standardised approach to the logical layout of information within the written, non-itemised report should be used to facilitate the rapid reading of reports by referrers.

Recommendation(s):
Reports should be as concise as possible while still conveying the information required to highlight key findings and to answer the clinical question.

B. Templates

Evidence: 4/4 Surveys showed strong reader preference for itemised or structured reports as against prose reports (6, 21, 28, 29). The randomised controlled trial found no objective difference between prose and itemised reports in accuracy, speed or efficiency of report analysis; however, medical student participants preferred itemised reports in terms of accuracy, speed and efficiency, and certainty of reading, particularly with regard to positive and negative findings, and ‘what has not been mentioned’ (6). Structured reports were identified in 1/2 audits (13). In this study, reports from one imaging service were almost entirely produced on structured templates and were more likely to be complete with respect to desired content of history, complete anatomic localisation, full imaging description and clinical correlation than reports from other providers that were almost all in prose format (13).

1/4 Guidelines considered structure, advising that compliant standardised formats were acceptable (2), and 1/4 contained detailed itemised report content (5).

Clinical examples of disease processes/examination types that can benefit from the use of report templates are:

- cancer staging;
- breast imaging including MRI;
- antenatal ultrasound for morphologic abnormality screening;
- coronary artery CT angiography;
- paranasal sinus CT scanning for sinus inflammatory disease;
- CT colonography; and
- temporal bone CT for congenital hearing loss.
Comment

Itemisation of report elements using a standardised template can improve completeness of reports for examinations that relate exclusively or mainly to specific disease process(es) and are recommended for these examinations. They also can act as an aide memoire to the radiologist regarding the important elements requiring evaluation and inclusion in the report, potentially reducing errors as a result of omission, and improving efficient and consistent reporting of imaging information by different radiologists. Examples are appended to this guideline (Appendix 5).

A recent cohort study of structured reporting software found a significant decrease in report accuracy and completeness in an intervention group using point-and-click structured reporting software compared to controls using prose dictation. This was attributed to the constraints of the particular software package used and the distraction that use of the software may have created for the radiologist. The Panel noted that the evidence is currently inconclusive, but that the value seems clear. They also agreed that a logical structure to the reporting of findings is valuable.

The idea of structured reporting was supported, but there were perceived issues with implementation:

- templates should be constructed to cover everything that should be communicated to the referrer; and
- where possible, templates should be developed at a national level and enable eHealth functionality when feasible.

There was also agreement that to facilitate structured reports, the following are desirable:

- definition of terms such as ‘structured report’ ‘minimal dataset’ and so on; and
- acknowledgement that in some settings a standard format is not appropriate.

Recommendation(s):
Standardised examination/disease process – specific report templates should be developed to meet the needs of specific referrer groups.
2. **Accuracy**

**Evidence:** Accurate communication was highly important for respondents in 1/1 survey (22). Reports were more likely to be in error when they contained statements with low confidence modifiers \((p < 0.01)\), statements with low anatomic specificity \((p < 0.001)\) and supplemental comments; for example, about exam quality \((p < 0.001)\) (12). There was no significant difference between the accuracy, speed or efficiency of information extraction from structured and prose reports (6).

Although not strictly related to the form and content of the written report, many of the studies (20, 22, 24, 28) and guidelines (2–4) also addressed issues of timeliness of provision of the report, communication of discrepancies between an original verbal or written report and the final report, and proofreading.

**Comment**

Standardised terminology for radiological observations is anticipated. Examples in current use/development include RADLEX, BI-RADS and SNOMED-CT. Use of such a standardised lexicon by radiologists in future may contribute to report clarity.

**Recommendation(s):**

1. The written radiology report should focus on accurate communication of pertinent examination findings and their interpretation. Reports should include:
   - use of terminology with commonly agreed meaning; and
   - use of anatomically specific lesion localisation.

2. When an initial report (verbal or written) about an examination is provided and the final report differs in a manner that could alter diagnosis or management, it is the responsibility of the radiologist to ensure that:
   - the discrepancy is documented in the written report; and
   - people involved in the care of the patient are made aware of the discrepancy and the notification process is documented.

3. Discrepancy documentation should be clearly separated from the original report and be added as an addendum with a date, time and authorship of the radiologist providing the addendum.
3. Language

Evidence: There was wide variation in the terms used to describe imaging characteristics and pathology in 1/2 audits (16). Primary care practitioners in 1/1 surveys disliked the use of unfamiliar and undefined terms (19). 3/4 Guidelines considered language, advising that it should be precise/appropriate (2, 3) and tailored to the referrer level of familiarity (4). A large number of expressions were used to express the probability of a disease being present or absent in 1/1 audit (16). 2/2 Surveys found that the majority of these were interpreted extremely variably by readers (23, 25). Standardisation of language was advocated in the narrative review (30).

Recommendation(s):
See recommendations 2 and 4 with regard to use of language in the written report.

4. Clarity, certainty and readability

Evidence: Clarity was important in 1/4 guidelines (4), and was valued in 2/2 surveys (22, 24). Defined by the extent of agreement by readers about whether reports supported a diagnosis of pneumonia, clarity was positively associated with sentence length <60 characters (OR = 2.096), ≥3 pneumonia related observations (OR = 2.050), and negatively associated with <3 pneumonia related statements (OR = 0.269) and more than 25% pneumonia related observations modified by uncertainty related terms (OR = 2.82)(9).

Clarity was subjectively improved by editing (p < 0.007) (7). There was moderate negative correlation (kappa = –0.63) between Flesch–Kincaid readability scores (defined in terms of level of reading ability necessary to understand the text) and reader assessment of clarity (15). In the 2008 RANZCR survey of practitioners and radiologists, higher clarity was associated with use of unambiguous terminology and provision of a specific recommendation at the end of the report by the radiologist.

Reports were more likely to be in error when they contained statements with low confidence modifiers (p < 0.01) and supplemental comments; for example, about exam quality (p < 0.001) (12).

An expression of radiologist confidence level was supported by respondents to one survey (28), and interview respondents valued an indication about the probability of disease (19). Readers rated the certainty of the radiologist lower in reports with higher Flesch–Kincaid readability (kappa = 0.58, ref = Sierra).

There was no correlation between subjective impressions of readability and more formal assessment of readability of reports using Flesch–Kincaid scores (r = 0.04, p = 0.8) (7). Subjective readability improved with editing (p < 0.007) (7).

Comment

Although it is common in legal practice for a greater than 50% chance of something occurring (or being attributable to something else) to be defined as ‘probable’ and a less than 50% chance as ‘possible’, there is by no means a consistent understanding or analogous application of these words by radiologists in written reports. There has been progress made in the standardisation of
terminology relating to expression of probability (e.g. BI-RADS for likelihood of a breast lesion being malignant).

**Recommendations:**
The written report should:

- use short sentences in preference to long sentences in prose reports and in the free text fields of itemised reports; and
- avoid use of ‘low confidence modifiers’, such as ‘might be consistent with’ and ‘possibly represents’, that result in uncertainty as to the likelihood of diagnosis(es).

Radiologists should review and edit their own reports and those of trainees under their supervision to improve accuracy, clarity, readability, succinctness and logical order of examination findings, and their interpretation before finalising the report.

**OTHER ISSUES**
The Panel also raised a number of issues that, while beyond the immediate scope of this guideline, were important considerations for guideline interpretation, implementation, evaluation and further development. These are described below.

**Variation in current practice**
The Panel noted that while there was little rigorous evidence of variation in practice on the generation of written reports, their experience was that, in the absence of standards, there was wide variation in the structure, format, content and quality of the written report between settings and practitioners.

As a result, the recommendations of this guideline aim to describe the best, rather than current standard, practice in generation of the written radiology report.

**Resource implications**

**Templates**
The Panel noted that adoption of the guideline recommendations would require reporting templates to be developed that were relevant to the needs of specific craft groups; for example, oncologists. This would require substantial resources and time.

The Panel highlighted that the time cost of developing reporting templates at a sub-speciality, national or college level was likely to be much less than the recurring cost of incomplete reports or the cost of individual radiologists developing their own templates.

The Panel also agreed that there would be issues to be solved in terms of implementation costs and the feasibility of broad adoption of developed templates onto RIS/PACS.

It was noted that incentives for implementation of these new systems may need to be incorporated into the Medical Benefits Schedule(MBS) and other funding arrangements with providers.
Training
It was foreseen that there would be a cost to RANZCR and radiology practices of incorporating new guidelines into the training curriculum, examination systems, continuing professional development programs and operational systems within practices. This was expected to diminish over time, after materials are developed.

The Panel emphasised that implementation of a standardised lexicon must be easy and not compromise workflow or the radiologist’s primary role of image interpretation. It was also acknowledged that there would be time costs for learning new processes.

The guideline recommendation for radiologists to edit trainees’ reports was strongly supported by the Panel. The Panel noted, however, that this may require a change in workflow and resource allocation in departments responsible for training.

Communication of test results
The Panel agreed that there were many aspects of communication between the referrer, patient and radiologist that were important beyond the writing of the written report.

The Panel believes that there needs to be a shared understanding between the radiologist and the referrer about who is responsible for taking consent and explaining the risks of a procedure, and giving the results to the patient.

Whether or not results should be directly communicated by the radiologist to the patient was agreed by the Panel to be contextual and dependent on the nature of the examination, availability and accessibility of the referrer, the urgency with which the information needed to be conveyed, and the nature of the findings. The Panel agreed that this was a related, but separate, issue to the written report and specific guidance was outside the scope of this guideline.

The Panel also noted that many patients read their reports before seeing their referring practitioner and that this needs to be taken into account when writing the report.

Other considerations
The Panel highlighted that many of the guideline recommendations might also be relevant to other non-radiologist specialists who generate imaging reports (e.g. vascular surgeons, cardiologists, obstetricians). Dissemination of the guideline to these other craft groups would be valuable.

It was also noted that changing patterns of referral to radiologists, including increasing rates of non-physician test-ordering, may influence the requirements for written reports.

Areas for further research
The Panel agreed that areas of potential future research could include:

- Measurement of and evaluation of implementation of guideline recommendations, including examination of the costs. The Panel emphasised that this evaluation should include an economic component.
• Interrupted time series studies and randomised controlled trials to test the effect of specific interventions to improve report quality.
• Investigation of the effect of standardised reporting templates on quality of reporting and communication.
• Observational studies of the factors associated with uptake (barriers and facilitators of guideline use) and impact of use of the guideline.

UPDATING THE GUIDELINE

Timing and nature of future updates will depend on:
• technology changes and e-health agenda;
• the response from the radiology profession after the guideline has been implemented; and
• feedback from other craft groups.

The proposed timeline for review is 3 years, contingent on the aforementioned issues.

IMPLEMENTATION AND DISSEMINATION ISSUES

It is anticipated that the guideline dissemination/implementation process will begin with publication of the guideline on the RANZCR website and a proactive strategy of publicity to key stakeholders including the RANZCR Council, the Standards of Practice and Accreditation Committee, the Curriculum Advisory Committee (Radiology), the Department of Health and Ageing, other medical colleges and professional organisations involved in imaging (the ADIA, AIR, ASUM, etc.).

It was recognised by the Panel that radiology information systems and information technology solutions would be critical to efficient, workable and cost-effective implementation of many of the guideline recommendations. It was also acknowledged that these were not universally in use or even available as commercial products in Australia at the time of recommendation drafting. The lack of electronic support for things such as templated reports could act as a substantial barrier to implementation by increasing the time taken to generate a report using a templated (or minimum dataset) approach.

There will be considerable cost and manpower implications of guideline implementation. Curriculum development and dissemination of the guideline elements to trainees, as well as its examination in FRANZCR Part II examinations, will be associated with costs for RANZCR. Methods to streamline teaching and examination of the guideline content need consideration. The same considerations apply to dissemination of the guideline to existing Fellows through the Standards of Practice and Accreditation. The Department of Health and Ageing will need to consider the implications of incorporating the guideline recommendations into its requirements for diagnostic imaging (DI) accreditation, in particular, the cost to practices in implementation of the recommendations.

There will be costs involved in dissemination of the final guideline to non-radiologist providers of diagnostic imaging services, as well as referrers who now encompass a wide range of craft groups.
including nurse practitioners, allied health professionals, general practitioners and specialists. How to do this in the most cost-effective manner requires consideration by the RANZCR Council.
APPENDIX 1: Practitioner Survey

Objective

The purpose of this survey was to measure characteristics of reports generated by radiologists intended for general practitioners (GPs). Our primary objective was to compare characteristics of different types of radiology reports, and to assess these reports according to

- **clarity** (is it clear what the radiologist thinks the diagnosis(es) is or is not based on the written report),
- **quality** (how satisfied overall are you with this report) and
- **action** (would this report make you decide to do something in relation to treatment or further testing (either immediately or as soon as possible) that you would have not done without the report?)

A secondary objective was to compare the responses in these three dimensions between radiologists and GPs.

Methods

Four clinical scenarios were created for the purpose of this project. They included unresolving pneumonia on a chest radiograph, PV bleeding in the first trimester investigated with ultrasound, abdominal pain investigated with CT scanning, and transient hemiparesis and headache investigated with CT. For each scenario, four possible written reports were provided which included various combinations of the predictor variables (itemisation, integration, lack of ambiguity, and specific recommendation for further action) [see Appendix 1a of this appendix].

In order to maximise the response rate, it was determined that the survey should take no longer than 20 minutes to complete. In order to achieve this, it was necessary to provide only four different combinations of the four attributes (integration, ambiguity, itemisation, and recommendation). This meant that the effect of unambiguous terminology could not be separated from the effect of NOT integrating prior imaging and similarly the effect of LACK of itemisation could not be separated from the effect of making recommendations about further testing. However, a common sense decision was made that the respondents were unlikely to rate either lack of itemisation or lack of integration of previous imaging as a preferred attribute. Thus the complete confounding of unambiguous terminology and specific recommendation by these other variables was unlikely to be of importance.

An on-line survey (www.surveymonkey.com) was piloted with 7 primary care doctors and 13 radiologists who were asked to score each of the four versions on a 1 – 10 Likert scale for clarity, quality, and the likelihood of a change in clinical action as a result of the report.

Results were analysed using repeated-measures ordinal logistic regression models with adjustment for clustering within respondent using a Huber-White information sandwich method (Stata, 2008 version, College Station, TX). We estimated the odds ratios for increasing preference in rating scores between report formats and between craft groups. Survey of a larger, random selection, of providers and referrers will be performed in the near future.
Data Description

We received responses from 51 respondents (18 GPs and 33 radiologists). Each respondent provided a rating score between 1 and 11 for “Clarity”, “Quality” and “Action” for each of four vignettes, with four modalities, viz. X-ray, Ultrasound, CT scan and MRI.

Six respondents (five radiologists, one GP) failed to complete the entire 48 questions of the survey. Four returned completely null responses, and two partial responses (each with six). All responses have been included in this analysis.

Results

Summary:

Thirty-three radiologists and 18 general practitioners participated in the survey and all were self-selected.

The report version containing a combination of unambiguous language and a clear recommendation for clinical action and / or further investigation was strongly preferred over other report styles, with the report containing itemised rather than prose style combined with integration of prior imaging information (but lacking specific recommendation and unambiguity) scoring lowest relative to baseline (OR 5.1, p<0.01, 95% CI: 2.973 to 8.740 and OR 0.7, 95% CI 0.4 – 1.2, respectively). The association was strongest for the scenario involving brain MRI (OR 19.178 p<0.001, 95% CI 4.799 to 76.649). Ratings for overall quality and clinical action also scored the combination of unambiguity and specific recommendation most highly (quality: OR 7.4, p <0.001, 95% CI: 4.396 to 12.496) action: 6.7, p<0.001, 95% CI: 2.950 -15.346).

Detailed Results:

The tables below shows the mean response score for three measures of “Clarity”, “Quality” and “Action”, by vignette (rows) and craft group & modality (columns).

The obvious conclusion from this table is that Vignette 3 is scores highest for all modalities and both craft groups.

Table 1: Clarity by vignette (rows) and craft group & modality (columns)

<table>
<thead>
<tr>
<th>Group and Modality</th>
<th>GP</th>
<th>Radiologist</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vignette X-Ray Ultrasound CT-scan MRI</td>
<td>Vignette X-Ray Ultrasound CT-scan MRI</td>
<td></td>
</tr>
<tr>
<td>Vignette 1</td>
<td>8.2</td>
<td>6.5</td>
</tr>
<tr>
<td>Vignette 2</td>
<td>8.3</td>
<td>6.6</td>
</tr>
<tr>
<td>Vignette 3</td>
<td>8.9</td>
<td>8.8</td>
</tr>
<tr>
<td>Vignette 4</td>
<td>7.2</td>
<td>6.2</td>
</tr>
</tbody>
</table>
Table 2: Quality by vignette (rows) and craft group & modality (columns)

<table>
<thead>
<tr>
<th>Group and Modality</th>
<th>GP</th>
<th>Radiologist</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vignette</td>
<td>X-Ray</td>
<td>Ultrasound</td>
</tr>
<tr>
<td>Vignette 1</td>
<td>8.0</td>
<td>6.7</td>
</tr>
<tr>
<td>Vignette 2</td>
<td>7.9</td>
<td>9.3</td>
</tr>
<tr>
<td>Vignette 3</td>
<td>9.2</td>
<td>10.1</td>
</tr>
<tr>
<td>Vignette 4</td>
<td>6.6</td>
<td>7.9</td>
</tr>
</tbody>
</table>

Table 3: Clinical Action by vignette (rows) and craft group & modality (columns)

<table>
<thead>
<tr>
<th>Group and Modality</th>
<th>GP</th>
<th>Radiologist</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vignette</td>
<td>X-Ray</td>
<td>Ultrasound</td>
</tr>
<tr>
<td>Vignette 1</td>
<td>7.7</td>
<td>7.1</td>
</tr>
<tr>
<td>Vignette 2</td>
<td>8.6</td>
<td>9.2</td>
</tr>
<tr>
<td>Vignette 3</td>
<td>9.5</td>
<td>9.8</td>
</tr>
<tr>
<td>Vignette 4</td>
<td>6.9</td>
<td>8.2</td>
</tr>
</tbody>
</table>

The mean scores by vignette, modality and craft group are shown in the dot chart presented below. The dot chart is useful, because it displays the results for each of the four vignettes on the same horizontal scale for each of the three outcome measures (clarity, quality & action) for the four modalities (X-ray, ultrasound, CT and MRI) for both craft groups (GP, radiologist).

Vignette 3 is consistently the greatest mean score for all 24 combinations.

Figure 1: Mean Scores (by vignette, modality and craft group)
Appendix 1: Practitioner Survey

It remains to consider the variability in scores, and to obtain confidence intervals for difference in scores across all the levels shown in figure 1.

The most appropriate linear model for the outcome of rating score is an ordinal regression model, since the response variable is subjective and not simply quantitative.

We fit three ordinal regression models, one for each outcome of clarity, quality and action. Each model fits simple main effects of vignette, modality and craft group, and an interaction term between vignette and modality (to estimate differences in effect of vignette between the four modalities).

Table 4: Clarity - ordinal regression model

| Covariate               | Odds Ratio | Std. Err. | P>|z|     | 95% Conf. Interval   |
|-------------------------|------------|-----------|--------|---------------------|
| Vignette                |            |           |        |                     |
| Vignette 1*             | 1.0        |           |        | (0.493 to 2.292)    |
| Vignette 2              | 1.063      | 0.417     | 0.877  | (0.493 to 2.292)    |
| Vignette 3              | 4.696      | 1.524     | <0.001 | (2.485 to 8.872)    |
| Vignette 4              | 0.562      | 0.187     | 0.083  | (0.292 to 1.079)    |
| Modality                |            |           |        |                     |
| X-ray*                  | 1.0        |           |        |                     |
| Ultrasound              | 0.308      | 0.111     | 0.001  | (0.152 to 0.625)    |
| CT-scan                 | 1.747      | 0.506     | 0.054  | (0.990 to 3.082)    |
| MRI                     | 4.253      | 1.241     | <0.001 | (2.401 to 7.533)    |
| Vignette & modality interaction |        |           |        |                     |
| Vignette 2 & Ultrasound | 18.453     | 9.799     | <0.001 | (6.517 to 52.248)   |
| Vignette 2 & CT-scan    | 2.877      | 1.146     | 0.008  | (1.318 to 6.280)    |
| Vignette 2 & MRI        | 0.679      | 0.263     | 0.318  | (0.318 to 1.451)    |
| Vignette 3 & Ultrasound | 10.367     | 5.018     | <0.001 | (4.014 to 26.773)   |
| Vignette 3 & CT-scan    | 1.915      | 0.680     | 0.068  | (0.954 to 3.841)    |
| Vignette 3 & MRI        | 1.012      | 0.363     | 0.974  | (0.501 to 2.044)    |
| Vignette 4 & Ultrasound | 13.961     | 7.326     | <0.001 | (4.992 to 39.044)   |
| Vignette 4 & CT-scan    | 0.607      | 0.276     | 0.272  | (0.249 to 1.480)    |
| Vignette 4 & MRI        | 0.660      | 0.234     | 0.242  | (0.329 to 1.323)    |
| Group                   |            |           |        |                     |
| GP*                     | 1.0        |           |        | (0.221 to 0.678)    |
| Radiologist             | 0.387      | 0.111     | 0.001  | (0.221 to 0.678)    |

* Baseline category

For Clarity, vignette 3 has a 5-fold increase in higher response probability than vignette 1, and this is particularly the case for ultrasound, compared with the other modalities. Overall, clarity responses were greater for MRI than other modalities for all vignettes. Generally, radiologists had 40% OR of awarding a lower score than GPs.

Table 5: Quality - ordinal regression model

| Covariate               | Odds Ratio | Std. Err. | P>|z|     | 95% Conf. Interval   |
|-------------------------|------------|-----------|--------|---------------------|
| Vignette                |            |           |        |                     |
| Vignette 1*             | 1.0        |           |        | (0.528 to 2.285)    |
| Vignette 2              | 1.099      | 0.411     | 0.801  | (0.528 to 2.285)    |
| Vignette 3              | 4.317      | 1.262     | <0.001 | (2.434 to 7.656)    |
| Vignette 4              | 0.385      | 0.116     | 0.002  | (0.213 to 0.696)    |
| Modality                |            |           |        |                     |
| X-ray*                  | 1.0        |           |        |                     |
| Ultrasound              | 0.361      | 0.119     | 0.002  | (0.189 to 0.690)    |
### Covariate

| Covariate                        | Odds Ratio | Std. Err. | P>|z|  | 95% Conf. Interval          |
|---------------------------------|------------|-----------|-----|-----------------------------|
| CT-scan                         | 1.526      | 0.467     | 0.167 | (0.837 to 2.782)          |
| MRI                             | 3.341      | 0.968     | <0.001 | (1.894 to 5.896)         |

**Vignette & modality interaction**

| Vignette & modality interaction | Odds Ratio | Std. Err. | P>|z|  | 95% Conf. Interval          |
|---------------------------------|------------|-----------|-----|-----------------------------|
| Vignette 2 & Ultrasound         | 15.236     | 6.687     | <0.001 | (6.446 to 36.011)         |
| Vignette 2 & CT-scan            | 3.482      | 1.561     | 0.005 | (1.446 to 8.383)          |
| Vignette 2 & MRI                | 0.915      | 0.369     | 0.825 | (0.414 to 2.019)          |
| Vignette 3 & Ultrasound         | 7.309      | 2.795     | <0.001 | (3.454 to 15.468)        |
| Vignette 3 & CT-scan            | 1.842      | 0.603     | 0.062 | (0.970 to 3.498)          |
| Vignette 3 & MRI                | 1.267      | 0.397     | 0.449 | (0.686 to 2.340)          |
| Vignette 4 & Ultrasound         | 11.239     | 5.517     | <0.001 | (4.294 to 29.416)        |
| Vignette 4 & CT-scan            | 1.257      | 0.589     | 0.626 | (0.970 to 3.148)          |
| Vignette 4 & MRI                | 0.788      | 0.295     | 0.524 | (0.378 to 1.640)          |

**Group**

| Group               | Odds Ratio | Std. Err. | P>|z|  | 95% Conf. Interval          |
|---------------------|------------|-----------|-----|-----------------------------|
| GP*                 | 1          | 0.083     | <0.001 | (0.176 to 0.517)          |

* Baseline category

Very similar results apply to the outcome “Quality” as do “Clarity”. Vignette 3 stands out as the highest scoring of the four vignettes and this greatest for ultrasound than other modalities. Radiologists rated most vignettes lower than did GPs.

**Table 6: Clinical Action - ordinal regression model**

**LOGIT formatted output**

Outcome variable: score, n=711

| Covariate                        | Odds Ratio | Std. Err. | P>|z|  | 95% Conf. Interval          |
|---------------------------------|------------|-----------|-----|-----------------------------|
| Vignette                         |            |           |     |                             |
| Vignette 1*                      | 1          |           |     |                             |
| Vignette 2                       | 1.933      | 0.722     | 0.078 | (0.929 to 4.021)          |
| Vignette 3                       | 4.685      | 1.483     | <0.001 | (2.519 to 8.712)        |
| Vignette 4                       | 0.372      | 0.122     | 0.003 | (0.195 to 0.707)          |

**Modality**

| Modality                       | Odds Ratio | Std. Err. | P>|z|  | 95% Conf. Interval          |
|--------------------------------|------------|-----------|-----|-----------------------------|
| X-ray*                         | 0.566      | 0.227     | 0.157 | (0.258 to 1.244)          |
| Ultrasound                     | 1.569      | 0.474     | 0.136 | (0.868 to 2.837)          |
| CT-scan                        | 2.679      | 0.916     | 0.004 | (1.371 to 5.236)          |
| MRI                            |            |           |     |                             |

**Vignette & modality interaction**

| Vignette & modality interaction | Odds Ratio | Std. Err. | P>|z|  | 95% Conf. Interval          |
|---------------------------------|------------|-----------|-----|-----------------------------|
| Vignette 2 & Ultrasound         | 5.146      | 2.658     | 0.002 | (1.870 to 14.160)         |
| Vignette 2 & CT-scan            | 2.448      | 1.027     | 0.033 | (1.076 to 5.570)          |
| Vignette 2 & MRI                | 0.967      | 0.373     | 0.932 | (0.455 to 2.058)          |
| Vignette 3 & Ultrasound         | 3.495      | 1.399     | 0.002 | (1.595 to 7.659)          |
| Vignette 3 & CT-scan            | 1.532      | 0.537     | 0.223 | (0.771 to 3.044)          |
| Vignette 3 & MRI                | 2.281      | 0.827     | 0.023 | (1.121 to 4.642)          |
| Vignette 4 & Ultrasound         | 9.617      | 5.016     | <0.001 | (3.460 to 26.731)        |
| Vignette 4 & CT-scan            | 0.906      | 0.371     | 0.809 | (0.406 to 2.021)          |
| Vignette 4 & MRI                | 1.063      | 0.423     | 0.878 | (0.487 to 2.319)          |

**Group**

| Group               | Odds Ratio | Std. Err. | P>|z|  | 95% Conf. Interval          |
|---------------------|------------|-----------|-----|-----------------------------|
| GP*                 | 1          | 0.120     | 0.002 | (0.197 to 0.698)          |

* Baseline category

In the case of “Action”, again vignette 3 was the stand-out method. Again, the effect for ultrasound was more marked than for other modalities, and uniformly, scores were greater for MRIs than other modalities. Again, radiologists awarded lower scores than did GPs.
Appendix 1a: Practitioner Survey: Vignettes

Vignettes and sample reports used in practitioner survey:

**SCENARIO ONE - ULTRASOUND**

Clinical Notes:

Report 1

- Test requested: Transvaginal US
- Technique: Transabdominal ultrasound. The patient refused transvaginal ultrasound.
- Comparative examinations: A previous pelvic ultrasound was performed at this facility 4 weeks ago.
- Uterus: Mild thickening of the endometrial echo.
- Ovaries:
  - Right: Normal
  - Left: Physiological corpus luteum of pregnancy
- Adnexae: No mass or other abnormality
- Kidneys: Normal
- Other findings: There was a small (normal) amount of free intraperitoneal fluid.
- Conclusion: Findings are compatible with either a very early intrauterine pregnancy (less than 7 weeks gestation) or an ectopic pregnancy or a complete abortion.

Report 2

Findings:
A transabdominal ultrasound was performed even though transvaginal scanning was requested as the patient refused transvaginal scanning. Explanation of the procedure to her was difficult due to poor understanding of English and an interpreter was not available at the time of scanning.

The uterus was anteverted and normal in size and showed an endometrial echo mildly increased in thickness. No gestational sac was seen in the uterus.

The right ovary contained a 2.3 cm cystic structure demonstrating “ring of fire” sign on Doppler examination.

No adnexal masses were seen.

Some free fluid was seen in the pouch of Douglas.

The kidneys were normal.

Review of the previous ultrasound (which was also transabdominal) performed 4/52 ago showed no evidence of an intrauterine pregnancy

Conclusion: No intrauterine pregnancy is seen. Ultrasound findings might be consistent with ectopic pregnancy or a spontaneous abortion. A normal intrauterine pregnancy is somewhat less likely if patient had a positive pregnancy test 9 weeks ago because a gestational sac is usually seen in the uterus on transabdominal scanning at 7 weeks and none is seen here. Daily beta HCG estimation might be helpful in determining which of the three possibilities is most likely.
Report 3

Findings:
A transabdominal ultrasound was performed even though transvaginal scanning was requested as the patient refused transvaginal scanning. Explanation of the procedure to her was difficult due to poor understanding of English and an interpreter was not available at the time of scanning.

The uterus was anteverted and normal in size and showed an endometrial echo mildly increased in thickness.

No gestational sac was seen in the uterus.

The right ovary contained a 2.3 cm cystic structure demonstrating “ring of fire” sign on Doppler examination was seen. This is diagnostic of a normal corpus luteum of pregnancy. The left ovary was normal and no adnexal masses were seen.

Some free fluid (physiological in amount) was seen in the pouch of Douglas.

The kidneys were normal.

Conclusion:
The observed combination of findings could be seen with an early normal intrauterine pregnancy, an ectopic pregnancy, or a spontaneous abortion.

Assay of the beta HCG level would help to distinguish between these possibilities. When beta HCG is over 6,500 IU and no gestational sac is seen in the uterus on transabdominal ultrasound the likelihood of ectopic pregnancy is more than 90%. If beta HCG is less than 6,500 today then the current ultrasound findings are still compatible with an early normal intrauterine gestation, a spontaneous abortion, or an ectopic pregnancy. Close clinical follow up is recommended until a definitive diagnosis is reached because ectopic pregnancy has not been excluded with a high degree of confidence at this stage.

Report 4

Technique:
• Transabdominal pelvic ultrasound.

Comparison examinations
• Pelvic US 4/52 ago

Findings:
• Uterus – endometrial echo increased in thickness. No gestational sac seen.
• Kidneys – Normal
• Pouch of Douglas – a small amount of free fluid containing no internal echoes noted
• Adnexa –
• Right - 2.3 cm cystic structure demonstrating “ring of fire” sign on Doppler examination diagnostic of corpus luteum noted. No other mass
• Left – Normal
• Ovaries
  o Right – Normal
  o Left – Normal

Limitations
Transvaginal ultrasound was suggested to the patient as a more accurate way of determining whether or not there was an early pregnancy in the uterus but she refused to have this done. It appeared that her understanding of English and of the procedure itself was limited.
I note that the patient had positive pregnancy test 9 weeks ago and a previous ultrasound was performed 4/52 ago to establish dating of the pregnancy but no gestational sac was seen in the uterus at that time.

**Interpretation**

Current findings may be compatible with an early normal intrauterine pregnancy, an ectopic pregnancy, or a spontaneous abortion. If the patient had a positive urine pregnancy test 9 weeks ago, a gestational sac would usually be demonstrable in the uterus by now if the patient had a normal intrauterine pregnancy that was ongoing.

**Scenario Two - X-Ray**

**Clinical Notes:**
53 yo male. Cough. Pneumonia demonstrated on previous CXR. 4/52 antibiotic treatment. Some improvement. Progress?

**Report 1**

**Examination:**
- Chest radiograph
- Comparison examination:
  Chest radiograph 5/52 ago. This was unavailable for comparison because the patient left his x-rays at home.

**Findings:**
- Lungs:
  - Right: Dense opacity containing air bronchograms seen in lower zone obscuring right heart border.
  - Left: Normal
- Mediastinum: Normal
- Bones: Normal
- Soft tissues: Normal

**Conclusion:**
Consolidation in the right middle lobe.

It is uncertain whether there has been any change since the previous radiograph.

If the consolidation was in this location and unchanged on the prior radiograph, this might represent incompletely treated pneumonia, due to lack of compliance with medication or inappropriate antibiotic therapy or a bronchoalveolar malignant lesion (bronchogenic carcinoma). Bronchoalveolar cell carcinoma or granulomatous disease (e.g. Wegener’s) can also appear similar to infective consolidation on plain radiographs.

**Report 2**

**Findings:** Comparison is made with CXR 5/52 ago. As on the previous examination, there is confluent opacity in the right lower zone obscuring the right heart border. This is unchanged from the prior radiograph.

**Conclusion:** No change in lung opacity in right middle lobe. CT scanning may be helpful for further evaluation.
Report 3

Findings: There is confluent opacity in the right lower zone obscuring the right heart border consistent with right middle lobe pathology. This contains air bronchograms which indicate alveolar consolidation. The patient left his previous radiographs at home and so a direct comparison was not possible.

Conclusion: Right middle lobe opacity could be infective consolidation but persistent consolidation should raise the possibility of an underlying malignancy or a non infective disorder such as granulomatous disease (Wegener’s), if the patient has been compliant with antimicrobial treatment. If persistent in this patient, consolidation should be evaluated with CT scanning to clarify the reason for persistence.

Report 4

Examination:
- Chest radiograph

Comparison examination:
- Chest radiograph 5/52 ago

Findings:
- Lungs:
  - Right: Dense opacity containing air bronchograms seen in lower zone obscuring right heart border.
  - Left: Normal
- Mediastinum: Normal
- Bones: Normal
- Soft tissues: normal

Conclusion:
- Consolidation in the right middle lobe unaltered compared with the previous radiograph.

**SCENARIO THREE - CT**

**Clinical:** 62 year old male. Chronic intermittent central abdominal pain. Previous CT scan of the abdomen for the same pain 18 months ago normal. Pain increasing in frequency and severity. Cholecystectomy 10 years ago.

Report 1

- Examination: CT scan of the abdomen with oral and intravenous contrast
- Comparative examination: CT scan of the abdomen and pelvis performed 18/12 ago.

Findings:
- Liver and bile ducts: Normal except for mild dilatation of the common bile duct which measures 9mm at the level of the porta hepatis.
- Spleen: Normal
- Stomach: Normal
- Kidneys: Normal
- Adrenals: Normal
- Pancreas: Pancreatic duct measures 4mm in diameter throughout the pancreatic head body and tail. No evidence of pancreatic mass, pancreatic enlargement, or calcifications.
- Retroperitoneum: Normal. No lymphadenopathy.
- Small bowel: Normal
- Large bowel: Normal
- Bladder: Normal
- Spine: Normal except for disc space narrowing from L3-S1 inclusive.
- No ascites

Conclusion
The dilatation of the common bile duct could be due to
- prior cholecystectomy as this is a common cause of mild CBD dilatation
- distal common duct obstruction (due to a tumour or a small stone) coexisting with post cholecystectomy dilatation Distal duct obstruction would be more likely than benign dilatation of the duct if the common bile duct had enlarged over time since the cholecystectomy.

Pancreatic duct dilatation could be due to
- an early pancreatic head cancer. The pancreatic duct dilatation would be much more concerning if it is new.
- pancreatitis in the past leading to a pancreatic duct stricture causing proximal dilatation of the duct.

Early pancreatic cancer needs consideration as a cause for the current findings in this clinical setting. The likelihood of this would be even higher if the pancreatic and common bile duct dilatation had progressed over time.

Report 2:
Clinical: 62 year old male. Chronic intermittent central abdominal pain. Previous CT scan of the abdomen for the same pain 18 months ago normal. Pain increasing in frequency and severity. Cholecystectomy 10 years ago.

A CT scan of the abdomen with oral and intravenous contrast has been performed.

The main pancreatic duct is dilated, measuring 4mm throughout its length. There is no evidence of a pancreatic head mass.

The liver appears normal. Cholecystectomy noted. The common bile duct is mildly dilated throughout its length, measuring 9mm in diameter.

The kidneys, adrenals, and remainder of the retroperitoneum are normal. The spleen is normal. The large and small bowel are normal. There is no ascites. The spine is normal apart from mild disc degenerative changes in the lower lumbar region.

Comparison with the previous CT scan 18 months ago shows that the common bile duct measured 7mm at that time and the pancreatic duct was not dilated.

Conclusion: Progressive dilatation of the common bile and pancreatic ducts since the prior CT 18 months ago without evidence of a cause. Further evaluation with high resolution CT scanning of the pancreas may be helpful to demonstrate the cause of the pancreatic and common bile duct dilatation. If this is unhelpful, consideration should be given to MRI or possibly ERCP.
Report 3:

Clinical: 62 year old male. Chronic intermittent central abdominal pain. Previous CT scan of the abdomen for the same pain 18 months ago normal. Pain increasing in frequency and severity. Cholecystectomy 10 years ago.

A CT scan of the abdomen with oral and intravenous contrast has been performed.

The main pancreatic duct is dilated, measuring 4mm throughout its length. There is no evidence of a pancreatic head mass.

The liver appears normal. Cholecystectomy noted. The common bile duct is mildly dilated throughout its length, measuring 9mm in diameter.

The kidneys, adrenals, and remainder of the retroperitoneum are normal. The spleen is normal. The large and small bowel are normal. There is no ascites. The spine is normal apart from mild disc degenerative changes in the lower lumbar region.

Conclusion:

Dilatation of the pancreatic and common bile ducts without evidence of a cause.

Possible explanations for this include:

1. An early cancer of the pancreatic head causing obstruction of both ducts.
2. Benign dilatation of the common bile duct post cholecystectomy which is a recognised and asymptomatic association of cholecystectomy, with another cause of pancreatic duct dilatation such as a small cancer or stricture due to prior pancreatitis.

Early pancreatic cancer needs exclusion in this patient, so it is strongly recommended that high resolution CT scanning of the pancreatic head be performed to try to demonstrate a mass. If a mass is not demonstrated, this still does not rule out an early pancreatic cancer as the cause for the current symptoms and imaging findings. Evaluation with ERCP or MRI would be indicated if high resolution CT is unhelpful.

Report 4


Examination: CT scan of the abdomen with oral and intravenous contrast.

Comparative examinations: CT scan of the abdomen and pelvis performed 18/12 ago.

Findings

- Liver and bile ducts: Normal except for mild dilatation of the common bile duct which measures 9mm at the level of the porta hepatis.
- Gallbladder: Absent. Clips are seen in the gallbladder fossa.
- Spleen: Normal
- Stomach: Normal
- Kidneys: Normal
- Adrenals: Normal
- Pancreas: Pancreatic duct measures 4mm in diameter throughout the pancreatic head body and tail. No evidence of pancreatic mass, enlargement, or calcifications.
- Retroperitoneum: Normal. No lymphadenopathy.
- Small bowel: Normal
- Large bowel: Normal
- Bladder: Normal
• Spine: Normal except for disc space narrowing from L3-S1 inclusive.
• No ascites

Prior Imaging Comparison:
• Review of the previous CT scan indicates that the dilatation of the common bile duct has progressed over time and that the pancreatic duct was not dilated previously.

Conclusion
• Progressive dilatation of the common bile and pancreatic ducts since the previous scan may be indicative of progressive obstruction of both ducts.

**SCENARIO FOUR - MRI**

**Clinical:** 36 y.o. female. Headache and left hemiparesis 9/7 ago. Now resolved. CT showed ?right basal ganglia abnormality.

**Report 1**

• Technique: A pre and post contrast MRI of the brain and MR angiogram were performed.
• Prior CT scan without intravenous contrast 9/7 ago performed at this hospital.

**Findings:**
• Ventricles: Normal
• Extraaxial spaces: Normal for age. No evidence of haemorrhage.
• A 1.2 X 2.0 cm right parietal T2 hyperintense lesion is seen which is cortical in location and demonstrates mild contrast enhancement and no significant mass effect. It is mildly hyperintense on the diffusion weighted images and the ADC map indicates probable, but not definite, low signal in the same area consistent with diffusion restriction. Two further smaller T2 hyperintense lesions are seen in the posterior frontal cortex and these are not associated with any abnormality on diffusion weighted imaging. Brain parenchyma otherwise normal.
• MRA demonstrates a focal bulge consistent with an aneurysm measuring 6mm in diameter arising from the right middle cerebral artery bifurcation. Other cerebral vessels normal. In particular, no occlusions or contour irregularities are seen elsewhere.

**Conclusion:**
• The right parietal and posterior frontal lesions are highly likely to be subacute to chronic infarcts and arterial embolisation is the most likely underlying cause. The source of emboli could be cardiac, thoracic aortic or carotid arterial but embolic material may also be arising from the sac of the 6mm ipsilateral middle cerebral aneurysm. It is highly probable that this aneurysm is a berry aneurysm, because of its typical location and appearance, and a mycotic, dissecting, or post traumatic aneurysm are considered much less likely.

**Report 2**

Pre and post contrast MRI of the brain and MR angiogram were performed.
A prior CT scan without intravenous contrast is noted, performed here 9/7 ago.

**Findings:**
Ventricular size and sulcal prominence are normal for a patient of this age.
A 1.2 X 2.0 cm right parietal T2 hyperintense lesion is seen which is cortical in location and demonstrates mild contrast enhancement and no significant mass effect. It is mildly hyperintense on the diffusion weighted images and the ADC map indicates probable, but not definite, low signal in the same area consistent with diffusion restriction. Two further smaller T2 hyperintense lesions are seen in the posterior frontal cortex and these are not associated with any abnormality on diffusion weighted imaging. Brain parenchyma otherwise normal, in particular, there appears to be no basal ganglia lesion.

MRA demonstrates a focal bulge consistent with an aneurysm measuring 6mm in diameter arising from the right middle cerebral artery bifurcation. Other cerebral vessels normal. In particular, no occlusions or contour irregularities are seen elsewhere.

**Conclusion:**
The right parietal and posterior frontal lesions could be embolic infarcts. 6mm right middle cerebral artery aneurysm.

Review of the prior CT suggests that the basal ganglia lesion seen on the previous CT scan may be artifactual as there appears to be no abnormality on the current MRI.

CT angiography and neurosurgical referral should be considered.

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**Report 3**

Pre and post contrast MRI of the brain and MR angiogram were performed. A prior CT scan without intravenous contrast is noted, performed here 9/7 ago.

**Findings:**
Ventricular size and sulcal prominence are normal for a patient of this age.

A 1.2 X 2.0 cm right parietal T2 hyperintense lesion is seen which is cortical in location and demonstrates mild contrast enhancement and no significant mass effect. It is mildly hyperintense on the diffusion weighted images and the ADC map indicates probable, but not definite, low signal in the same area consistent with diffusion restriction. Two further smaller T2 hyperintense lesions are seen in the posterior frontal cortex and these are not associated with any abnormality on diffusion weighted imaging. Brain parenchyma otherwise normal.

MRA demonstrates a focal bulge consistent with an aneurysm measuring 6mm in diameter arising from the right middle cerebral artery bifurcation. Other cerebral vessels normal. In particular, no occlusions or contour irregularities are seen elsewhere.

**Conclusion:**
The right parietal and posterior frontal lesions are almost certainly embolic infarcts. They may have arisen from the heart, aorta, carotid arteries, or the middle cerebral artery aneurysm sac as these sometimes contain thrombus.

The aneurysm is typical in location for a simple berry aneurysm and other kinds of aneurysm such as mycotic or post traumatic are much less likely.

Urgent neurosurgical referral and CT angiography for treatment planning are recommended because of the risk of aneurysm rupture. It is possible that the headache the patient had 9/7 ago may have been the result of a “warning” bleed from the aneurysm.
Report 4

- Technique: A pre and post contrast MRI of the brain and MR angiogram were performed.
- Prior CT scan without intravenous contrast 9/7 ago performed at this hospital.

Findings:
- Ventricles: Normal
- A 1.2 X 2.0 cm right parietal T2 hyperintense lesion is seen which is cortical in location and demonstrates mild contrast enhancement and no significant mass effect. It is mildly hyperintense on the diffusion weighted images and the ADC map indicates probable, but not definite, low signal in the same area consistent with diffusion restriction. Two further smaller T2 hyperintense lesions are seen in the posterior frontal cortex and these are not associated with any abnormality on diffusion weighted imaging. Brain parenchyma otherwise normal. In particular, the basal ganglia are normal.
- MRA demonstrates a focal bulge consistent with an aneurysm measuring 6mm in diameter arising from the right middle cerebral artery bifurcation. Other cerebral vessels normal. In particular, no occlusions or contour irregularities are seen elsewhere
- Comparison with prior CT indicates that the basal ganglia lesion was probably artifactual. The previous CT also shows no evidence of subarachnoid haemorrhage related to the aneurysm. However, small amounts of haemorrhage or haemorrhage more than 24 hours old may not be evident on CT scanning.

Conclusion:
- The right parietal and posterior frontal lesions could be infarcts. 6mm aneurysm of the right middle cerebral bifurcation noted.
APPENDIX 2: Literature Review

Quality of the written radiology report – a review of the literature

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Conflict of Interest Notification Page

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Abstract

Purpose
A literature review was carried out, guided by the question: “What are the important elements of a high quality radiology written report”?

Methods
Two papers known to the authors were used as a basis for five PUBMed search strategies. Exclusion criteria were applied to retrieved citations. Reference lists of retrieved citations were scanned for additional relevant papers and exclusion criteria applied to these. Websites of Radiology professional organisations were scanned for guidelines relating to the written radiology report. Retrieved guidelines were appraised using the AGREE instrument. Methodologies of retrieved papers were not suitable for conventional appraisal and an evidence table was constructed.

Results
The search strategy identified 25 published papers and 4 guidelines.

Published study methodologies were: 1 randomised controlled trial, 1 before and after study of interventions, 10 observational studies/audits/analyses, 12 surveys, and one narrative review of the literature.

Conclusions:
Existing guidelines have a number of weaknesses in regard to scope and purpose, methods of development, stakeholder consultation and editorial independence and applicability. There is a major gap in published studies relating to testing of interventions to improve report quality using conventional randomized controlled trial methods. Published studies and guidelines generally support report content including clinical history, examination quality, description of findings, comparison and diagnosis. Important report attributes include accuracy, clarity and certainty. There is wide variation in the language used to describe imaging findings and diagnostic certainty. Survey participants strongly prefer reports with structured or itemised formats, but few studies exist regarding the effect of report structure on quality.

One sentence summary:
A review was carried out of guidelines and published articles concerning contributors to quality in the written radiology report.

Key Words: Literature review, quality improvement, radiology reporting.
INTRODUCTION

The written radiology report is the dominant method by which radiologists communicate their interpretation of imaging findings. The quality of the report therefore has a direct impact on the safety and appropriateness of decisions about treatment and further investigations. The written report also may be used in education or research, serve as a legal document and/or provide billing information. Several clinical practice guidelines and a number of publications in the radiology literature have considered the style, content, timeliness, and clarity of the written radiology report and how it might be improved. The Royal Australian and New Zealand College of Radiologists, through the Quality Use of Diagnostic Imaging Program, carried out a literature review guided by the question: “What are the important elements of a high quality radiology written report”?

The aims of this literature review were to: 1) Identify the evidence relating form and content of the written radiology report to objective or subjective measures of quality (such as clarity, utility, comprehensiveness, and extent to which the report addresses the key question(s) posed in the clinical notes provided in the referral for imaging); 2) Determine significant gaps in the evidence that could be filled by further research, such as a practitioner (provider and/or referrer) survey; and 3) Use the information from the literature review and the subsequent survey to inform the development of guidance for curriculum development and evidence based clinical practice guideline development regarding the radiology report by the Royal Australian and New Zealand College of Radiologists.

METHODS

Identification of Professional Standards of Radiology Reports

The websites of the American College of Radiology (ACR), Royal College of Radiologists (RCR), Royal Australian and New Zealand College of Radiologists (RANZCR), European Society of Radiology, and Canadian Association of Radiologists (CAR) were searched for guidelines relating to reporting on 23/03/2009. Common issues addressed by the identified radiology reporting guidelines were identified and recommendations of each were summarized.

Systematic Review of the Literature on Standards of Radiology Reports

Data location and selection

Two papers by Sistrom et al (1) and Houssami et al (2) relating to the issue of quality in written radiology reports were known to the authors of this review. A variety of PUBMed search strategies were undertaken, based initially on MESH headings associated with these two papers, combined with the words AND/OR (Figure 1). The greatest number of total citations was retrieved using the “Related Articles” function for the two original citations. Medline was searched on 27/07/2009. The retrieved citations were reviewed independently by both authors according to exclusion criteria (see below). Differences were resolved by consensus. Reference lists of retrieved papers were also scanned for relevant studies, using the same exclusion criteria.

Exclusion criteria were defined as: unrelated to the topic of interest, non English language publications, letters, editorials excluding narrative reviews of the literature, single case reports, publications relating primarily to natural language processing of the data in a radiology report, publications relating primarily to the encoding, transmission, and storage of the diagnostic imaging report, and publications relating primarily to voice recognition software and systems.
Evaluation of retrieved studies

As the retrieved studies were in the main, not efficacy studies, it was not possible to appraise them using established tools and conventional methods. Therefore, a summary of the study methodologies was produced. Significant findings were defined as: those associated with \( P<0.05 \), \( \text{OR}>2.0 \), \( \text{OR}<0.3 \), report attribute preferences or dislikes of greater than 66% of participants or mean report attribute importance of greater than 3.3/5 or 6.6/10 on Likert scales for surveys, and content items omitted in more than 33% reports.

Retrieved guidelines, recommendations and standards were appraised using the AGREE tool according to 6 Key domains (AGREE Collaboration. 2001)(1), summarized in Table 1.

The AGREE tool does not include an assessment of the quality of the evidence upon which guideline recommendations were based, even though it does evaluate whether recommendations are linked clearly with evidence. Therefore, a separate assessment was made about whether or not the evidence upon which the guideline was based had been appraised.

**Results**

No systematic reviews of this topic were identified.

**Radiology Reporting Guidelines, Recommendations and Standards**:

Three documents were retrieved from the websites of professional bodies, (the American College of Radiology (2), the Canadian Association of Radiologists (3) and the Royal College of Radiologists (4)). No guidelines were identified on the websites of the European Society of Radiology or Royal Australian and New Zealand College of Radiologists. A citation for a further guideline (SIR) was discovered during the Pubmed search process (5).

The results of appraisal of guidelines using the AGREE instrument are presented in Table 2 with key guideline recommendations summarized in Table 3. Written Radiology Report Guideline Results. It should be noted that the AGREE instrument was designed to assess clinical guidelines for individual patient management rather than for the appraisal of guidelines relating to diagnostic and reporting processes.

Existing guidelines set out objectives in general terms, but most do not specify target users, clinical scenarios, or patient groups. No guidelines describe involving consumers/patients in development, and only one documents fully how evidence was collected or evaluated and potential conflicts of interest. None of the guidelines explicitly link recommendations to evidence or document having been externally reviewed prior to publication. None of the guidelines describe having been piloted, nor do any address implementation issues such as potential organisational barriers and cost implications. All of the guidelines present key recommendations reasonably clearly, but none address implementation and compliance or contain tools for application.

**Systematic Review of the Radiology Reporting Literature**

The methods employed and attributes examined by these studies are summarized in Table 4.

A total of 25 papers were retrieved following the Pubmed search, application of exclusion criteria, scanning of reference lists of included studies and application of exclusion criteria to these additional references. One non-blinded randomised controlled trial (6), one before and after study (7), ten analyses/audits (8-17), twelve surveys (18-29), and one Narrative review of the literature
Four studies used more than one methodology (6, 12, 15, 28). The randomised controlled trial surveyed participants afterwards (6), two audits made use of survey findings, (12, 15), and one survey study also carried out an audit (28). The randomised controlled trial used a crossover methodology to test medical students on the accuracy and speed of responses to questions about reports for the same abdominal ultrasound, abdominal CT and head CT cases presented randomly in either prose or itemised formats (30). The before-and-after design assessed the effect of editing by staff radiologists on the subjective clarity, readability, brevity, conclusion quality, and Flesch-Kincaid readability of resident-written body CT reports (7).

Observational studies analysed reports quantitatively using word and character counts (8, 9, 11) and Flesch-Kincaid readability of the report (15) which was compared with a subjective assessment of clarity and certainty as judged by family practice referrers. Contribution of the report to management relative to clinical stage was graded in one paper (14). A measure of clarity was derived from the extent of agreement between physician readers about whether chest radiograph reports confirmed or excluded pneumonia (9); “Communication value” elements of chest radiograph reports (defined as presence or absence of: repetition in report body, logical statement order, succinctness, impressions containing only significant diagnoses, and final diagnoses based on content of the report body), were defined by a prior physician survey and applied subjectively (12). Audits evaluated reports from a wide variety of modalities for completeness against a wide range of specific content items and for readability (10, 17), clinical relevance (10, 17), and certainty (16).

Survey participants were drawn from a wide range of medical specialities, including primary care (19, 21, 25, 26, 28) and radiology (14, 20, 23-25). At the time of this review no surveys of patients had been published. Most surveys used similar general question types to evaluate views about report content items and attributes. Our studies examined reader preferences among groups of hypothetical sample reports setting out common clinical and imaging scenarios in varying degrees of detail (21, 27, 29) and format (21, 28, 29), three in combination with general questions (21, 28, 29).

Two of the surveys assessed radiologist and clinician interpretation of expressions commonly used to convey diagnostic certainty, one by plotting on a visual analogue scale (23) and the other by ranking in order of probability of disease being present or absent (25).

Identified limitations of studies included: low response/report retrieval rates/total numbers (10, 18, 24, 28, 29), non-respondents not surveyed (18, 24), non-representative referrers and reports (10), generalisability from subjects (21, 22, 27), generalisability from study institutions (7, 14, 18, 22, 24, 25, 29), limited range of examination types (7, 21, 29), limited clinical scenarios (14, 27), limited characteristics studied (9, 27) report accuracy not assessed (10, 14), request accuracy not assessed (14), subjective outcome (7, 10), no validated survey instrument (24), survey bias (27).

A number of common themes relating to report quality emerged from the guidelines and papers that comprise the current review, regardless of methodology.

Results are expressed in terms of the number of papers with significant findings relative to the total number of papers of each type addressing the theme.

**Report content**

- A statement of the clinical information available to the radiologist at the time the report was created is recommended in 3/4 guidelines (2, 4, 5) and 1/3 surveys (28), This information was missing from a significant proportion of written reports in 1/2 audits (28).
• Technical details are recommended in 3/4 Guidelines, with the provision that this may be instead documented elsewhere in the medical record (2, 3, 5). Technical information was valued in 1/3 surveys (28), but not by primary care practitioners in another 1/3 surveys (21). Technical data was incomplete in reports assessed by 1/3 audits. Contrast information, including documentation of consent but not the issues discussed was important in 1/3 surveys (28), but disliked by primary care practitioners in 1/3 surveys (21). 1/1 survey respondents specifically wanted contrast and other reactions to be documented in the report (26).

• A statement about overall examination quality and limitations is considered important in 2/4 Guidelines (2, 3), and was a preference in 5/5 surveys (21, 22, 26, 28, 29).

• A description of findings in general is prescribed in (4/4 guidelines (2-5) and valued in 2/2 surveys (22, 26). Many papers differentiated between the description of normal and abnormal findings.

**Abnormal findings:**

Precise anatomic localisation was frequently omitted in reports in 1/2 audits (13). Anatomic specificity was significantly associated with logical report order, succinctness and conclusions containing significant diagnoses based on the description (12).

Imaging characteristics such as lesion shape and margins were not fully described in a significant number of reports in 2/2 audits (11, 13).

Measurements of significant incidental abnormalities were valued by radiologists and clinicians in 1/1 surveys (28).

**Normal findings:**

Review of imaged regional anatomical structures was incomplete in a high proportion of reports in 1/1 audit (16).

“Pertinent negatives” relating to an abnormal finding were considered important in 2/3 surveys (24, 28), particularly for non-radiologists (24), this item was omitted from a significant number of reports in 1/1 audit (28).

• A comparison with previous study(ies) is advised in 2/4 Guidelines (2, 3) and was important in 2/2 surveys (22, 28), but this item was frequently omitted from reports in 2/3 audits (16, 28).

• A pathophysiologic diagnosis, where applicable is considered important in 2/4 Guidelines (2, 3) and in 1/1 survey (22).

• Differential diagnoses are advocated “when appropriate” by 2/4 guidelines (2, 3), and were valued in 1/2 surveys (22).

• Clinical correlation and/or answering the clinical question is recommended in 2/4 guidelines (2, 3) and is important in 3/3 surveys (19, 22, 26).

• Recommendations, particularly for further imaging and other investigations are advocated by (3/4 guidelines (2, 3, 5) and are valued in 6/6 surveys (19, 21, 22, 26, 28, 29), but they
were frequently omitted in reports evaluated by 1/3 audits (28). Primary care practitioners are most supportive of recommendations for referral and treatment (21). Respondents to the single survey addressing this issue said they “might be compelled to follow an explicitly worded recommendations” (6).

- Conclusion/Opinion/Impression, comprises several elements according to different authors. A diagnosis is required by 4/4 Guidelines (2-5). However, 2/4 guidelines modify this recommendation for brief reports (2) or stable comparisons with recent imaging (3). 3/4 surveys indicated a preference of respondents for reports containing a conclusion (21, 28, 29). 1/1 survey respondents felt that a separate conclusion should only contain significant diagnoses based on previous description in the report body (12). Other “conclusion” components recommended by individual guidelines were correlation with clinical factors (4), specific recommendations (2), and documentation of any adverse reactions related to the procedure (2), and this was also considered important in one of the surveys (26). The conclusion was not clearly defined in a significant proportion of reports in 2/5 audits (11, 28). The quality of the conclusion was subjectively improved by editing (7).

In the 4 studies presenting reports with different levels of content detail preferences were for more detailed reports for all clinical scenarios (21, 27-29), except for a normal chest radiograph performed because of symptoms outside the chest, when single statements containing an opinion or pertinent negative findings and comparison only were favoured (27). The content items contained in preferred reports were: clinical history (27), technique (27), quality (27), description of abnormal findings with measurements (21, 27, 29), description of regional normal structures (21, 27, 29), pertinent negatives (27), comparison (27), clinical correlation (21, 29), recommendations (21, 29), conclusion in report body (27) and separate conclusion (21, 29). Single statement reports were rejected by respondents to 2/5 surveys (26, 29).

Overall completeness with respect to required content was highly valued in 2/2 surveys (22, 24, 26, 29). 4/8 audits found that at least one content item was omitted from reports a significant proportion of the time (11, 13, 16, 28). Consistency of content is advocated in the narrative review (30).

**Report Length:**

Brevity was considered important in 1/3 surveys (22). Resident reports were longer than staff (8) and succinctness was improved by editing (p<0.007) (7).

**Format:**

4/4 surveys showed strong reader preference for itemised or structured reports as against prose reports (6, 21, 28, 29). The randomised controlled trial found no objective difference between prose and itemised reports in accuracy, speed or efficiency of report analysis, however medical student participants preferred itemised reports in terms of accuracy, speed and efficiency and certainty of reading, particularly with regard to positive and negative findings and “what has not been mentioned” (6). Structured reports were identified in 1/2 audits (13). In this study reports from one imaging service were almost entirely produced on structured templates and were more likely to be complete with respect to desired content of history, complete anatomic localisation, full imaging description and clinical correlation than reports from other providers which were almost all in prose format (13).
Appendix 2: Literature Review

1/4 guidelines considers structure, advising that compliant standardised formats are acceptable (2), and 1/4 contains detailed itemised report content (5).

Language:
There is wide variation in the terms used to describe imaging characteristics and pathology in 1/2 audits (16). Primary care practitioners in 1/1 surveys disliked the use of unfamiliar and undefined terms (19). 3/4 guidelines consider language, advising that it should be precise/appropriate(2, 3), and tailored to the referrer level of familiarity(4). A large number of expressions are used to express the probability of a disease being present or absent in 1/1 audits (16). 2/2 surveys found that the majority of these are interpreted extremely variably by readers (23, 25). Standardisation of language is advocated in the narrative review (30).

Confidence and Certainty:
An expression of radiologist confidence level was supported by respondents to one survey (28), and interview respondents valued an indication about the probability of disease (19), Readers rated the certainty of the radiologist lower in reports with higher Flesch-Kincaid readability. Readability was defined as the reading ability required to understand a passage of text, indicating that longer, more complex sentences tended to convey an impression of less certainty than did shorter, more simply constructed sentences (15).

Clarity
Clarity is important in 1/4 Guidelines (4), and was valued in 2/2 surveys (22, 24). Defined by the extent of agreement by readers about whether reports supported a diagnosis of pneumonia, clarity was positively associated with interpretiveness/pathological specificity of the report (OR=5.597), sentence length <60 characters (OR=2.096), >= 3 pneumonia related observations (OR=2.050), and negatively associated with <3 pneumonia related statements (OR=0.269), lower interpretiveness (0.188), and more than 25% pneumonia related observations modified by uncertainty related terms (OR=2.82)(9). Clarity was subjectively improved by editing (P<0.007)(7). There was moderate negative correlation (kappa=-0.63) between readability scores (defined in terms of level of reading ability necessary to understand the text), and reader assessment of clarity.

Readability
There was no correlation between subjective impressions of readability and more formal assessment of readability of reports using Flesch-Kincaid scores (r=0.04, P=0.8)(7). Subjective readability improved with editing (p<0.007)(7).

Accuracy
Accurate communication was highly important for respondents in 1/1 survey (22). Reports were more likely to be in error when they contained statements with low confidence modifiers (p<0.01), statements with low anatomic specificity (p<0.001) and supplemental comments, for instance about exam quality (p<0.001)(12). There was no significant difference between the accuracy, speed or efficiency of information extraction from structured and prose reports (6).

Although not strictly related to the form and content of the written report, many of the studies(20, 22, 24, 28) and guidelines(2-4) also addressed issues of timeliness of provision of the report, communication of discrepancies between an original verbal or written report and the final report, and proofreading.
Discussion

Existing guidelines about the written radiology report do not fully document their objectives, evidence appraisal, or development methodology, and do not address implementation issues. Current and future guidelines should be integrated into radiology training programs and continuing professional development.

Published studies consist mainly of surveys or observational report audits/analyses. There is a major gap in published studies relating to testing of interventions to improve report quality using conventional randomized controlled trial methods. This may in part relate to a lack of established metrics against which to evaluate the various elements of report quality. This is particularly important in light of new reporting technologies.

Successful communication through the written report depends on how well the radiologist conveys the results of image interpretation and analysis and how easily the reader extracts this information. Two studies have specifically examined these processes. A recent cohort study of structured reporting software is the only paper identified to study the effect of report creation method on quality attributes. This paper found a significant decrease in report accuracy and completeness in an intervention group using point and click structured reporting software compared to controls using prose dictation. This was attributed to the constraints of the particular software package used and the distraction that use of the software may have created for the radiologist who also had to view and interpret the actual images (31). Future software developments for structured reporting need to be designed with the complexity of image viewing and interpretation in mind so that use of the software itself does not divide the attention of the radiologist to such an extent that interpretative errors result.

The reviewed randomised controlled trial is the only study of the accuracy of information extraction, and found no difference between prose or itemised reports (6). Tailoring reports to the known needs of a particular referrer may allow for more efficient communication, but must be balanced against providing necessary information to all potential readers, including patients.

This review has a number of limitations. The search methodology included only published papers and guidelines. Studies examining report quality in other medical specialities, particularly pathology were excluded, since these reports generally concern a more limited range of examination types and possible diagnoses. The review focussed on how imaging findings and interpretation are communicated in the written report, and how readers perceive information contained in the report. It does not address the factors affecting the quality of images or interpretation. The other ways radiologists communicate with clinicians and with one another were not examined. The clinical effect of the radiology report was not examined. Case reports were not included, particularly the extensive body of articles addressing medicolegal issues around written reports. Editorial pieces were not included even though some have been influential and are cited by retrieved papers.

A number of initiatives are seeking to improve the quality of the written radiology report. Classification systems such as BI-RADS (32), and the Australian Breast imaging classification (1-5) (33) have been developed to convey a summary of pathophysiologic information, the degree of certainty, and direction as to further management. These systems, however apply to a limited range of diagnoses and may be hard to replicate in other subspecialty areas of radiology where the range of pathology is more diverse. BI-RADS and RadLex and other lexicons are working to standardise the language used in written reports. Basic report structure is outlined by BI-RADS (32). Detailed
Appendix 2: Literature Review

itemised report content is proposed by the Australian National Breast and Ovarian Cancer Centre, in the recommendations one of one audit (33), and most recently in template reports being developed by RSNA (34) for a large range of examination types.

Implementation of guidelines and templates aiming to improve report quality - primarily through standardization of various elements of form and content, has lagged behind the development of the guidelines and templates themselves. As is often the case with even high quality clinical practice guidelines, uptake in practice is patchy without a considered approach to implementation, and in particular, the often significant barriers to their use in clinical practice. Future attempts to improve the quality of written communication by radiologists need to focus on how report quality and its impact on patient care can be measured. In this way, changes to practice in regard to the production and communication of the report can be evaluated more meaningfully.

References

2. American College of Radiologists. ACR practice guideline for communication of diagnostic imaging findings. Reston, VA American College of Radiology; 2005


Figures and Tables

Figure 2: Radiology Reports Search Strategies

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Search using all relevant MESH terms from initial papers</td>
<td>6 relevant citations 1 of the original papers</td>
</tr>
<tr>
<td>“Documentation/methods OR Medical history taking/methods OR Communication OR Medical records/standards AND Quality assurance OR Medical audit AND (Healthcare/organization &amp; administration OR Radiology information systems/organization &amp; administration OR Radiology/organization)”</td>
<td></td>
</tr>
<tr>
<td>Broader search using selected terms</td>
<td>2 relevant citations Including 1 of original papers</td>
</tr>
<tr>
<td>“Documentation/methods and Radiology Information Systems / organization”</td>
<td></td>
</tr>
<tr>
<td>Search using “Radiology AND Report AND Quality”</td>
<td>8 relevant citations 1 of the original papers</td>
</tr>
<tr>
<td>Search using “Radiology AND Writing AND Quality assurance in healthcare” (MESH term mapping from Radiology, Report, and Quality)</td>
<td>2 relevant citations Neither of the original papers</td>
</tr>
<tr>
<td>Related articles function for 2 original articles</td>
<td>20 relevant citations</td>
</tr>
</tbody>
</table>

Table 1: AGREE Tool – Domains and Explanation of their meaning

AGREE consists of 23 key items organised in six domains. Each domain is intended to capture a separate dimension of guideline quality.

The score for each domain is calculated as: (observed score – minimum possible score) / (maximum possible – minimum possible score) expressed as a percentage.

<table>
<thead>
<tr>
<th>Scope and purpose</th>
<th>the overall aim of the guideline, the specific clinical questions and the target patient population.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stakeholder involvement</td>
<td>the extent to which the guideline represents the views of its intended users.</td>
</tr>
<tr>
<td>Rigour of development</td>
<td>the process used to gather and synthesise the evidence, the methods to formulate the recommendations and to update them</td>
</tr>
<tr>
<td>Clarity and presentation</td>
<td>the language and format of the guideline.</td>
</tr>
<tr>
<td>Applicability</td>
<td>the likely organisational, behavioural and cost implications of applying the guideline.</td>
</tr>
<tr>
<td>Editorial independence</td>
<td>the independence of the recommendations and acknowledgement of possible conflict of interest from the guideline development group.</td>
</tr>
</tbody>
</table>
### Table III: AGREE Scores for existing guidelines on the written radiology report

<table>
<thead>
<tr>
<th>Guideline/ Domain</th>
<th>ACR (USA)</th>
<th>RCR(UK)</th>
<th>CAR (Canada)</th>
<th>SIR (USA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scope &amp; Purpose</td>
<td>67%</td>
<td>67%</td>
<td>58%</td>
<td>67%</td>
</tr>
<tr>
<td>Stakeholder Involvement</td>
<td>44%</td>
<td>44%</td>
<td>38%</td>
<td>50%</td>
</tr>
<tr>
<td>Rigour of Development</td>
<td>39%</td>
<td>42%</td>
<td>36%</td>
<td>61%</td>
</tr>
<tr>
<td>Clarity &amp; Presentation</td>
<td>50%</td>
<td>69%</td>
<td>50%</td>
<td>44%</td>
</tr>
<tr>
<td>Applicability</td>
<td>42%</td>
<td>42%</td>
<td>42%</td>
<td>25%</td>
</tr>
<tr>
<td>Editorial Independence</td>
<td>25%</td>
<td>25%</td>
<td>25%</td>
<td>63%</td>
</tr>
</tbody>
</table>

### Table IV: Evidence Table

<table>
<thead>
<tr>
<th>Authors, Year</th>
<th>Methods</th>
<th>Attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bosmans, 2008</td>
<td>Observational study§ 525/800 CT Abdomen(100 consecutive from 8 hospitals, excluding non-standard protocols)*</td>
<td>Content(Technique, Description, Diagnosis, Recommendation), Length, Format</td>
</tr>
<tr>
<td>Chapman, 2001</td>
<td>Observational study 292 CXR reports (217 randomly selected from 3 month period + 75 randomly selected from subsequent 3 month period with discharge diagnosis of pneumonia)</td>
<td>Content(Diagnosis, Differential Diagnosis), Length, Confidence and Certainty, Clarity</td>
</tr>
<tr>
<td>Clinger, 1988</td>
<td>Survey 251/587 referrers (42%RR after resend) largest respondent groups paediatrics, internal medicine, general surgery, mix staff/resident General questions, anonymous</td>
<td>Content (Clinical correlation, Conclusion), Length Clarity, Delivery</td>
</tr>
<tr>
<td>Coakley, 2003</td>
<td>Before and After study of intervention 50 CT Body scan reports by residents before and after editing by attending radiologist evaluated in random order by physicians, radiologists</td>
<td>Content (Conclusion), Length, Clarity, Readability</td>
</tr>
<tr>
<td>Cook, 1991</td>
<td>Observational study (audit) 104/170 investigations (1 requested randomly from each of 10 classification groups for 17 weeks and able to be retrieved)</td>
<td>Content (Diagnosis, clinical correlation, conclusion) Readability</td>
</tr>
<tr>
<td>Espeland, 2007</td>
<td>Survey(Group Interviews discussing plain radiography for back pain) Purposeful sample 13 Primary Care practitioners, different experience and practice types</td>
<td>Content item: Clinical correlation, Recommendations Language</td>
</tr>
<tr>
<td>Gorman, 2007</td>
<td>Six Sigma quality improvement project Key physician interviews 6 Benchmarking survey</td>
<td>Delivery issues</td>
</tr>
<tr>
<td>Grieve, 2009</td>
<td>Survey* 60/100 referring primary care practitioners (60% RR), reading up to 10 reports/week General questions Sample report preferences (normal ultrasound for right</td>
<td>Content Items: History, Technique, Contrast protocol, Examination quality, description, recommendations, opinion Clarity and Certainty</td>
</tr>
<tr>
<td>Authors, Year</td>
<td>Methods</td>
<td>Attributes</td>
</tr>
<tr>
<td>--------------</td>
<td>---------</td>
<td>------------</td>
</tr>
<tr>
<td>upper quadrant pain ?gallstones and abnormal ultrasound for weight loss ?malignancy</td>
<td>Format</td>
<td></td>
</tr>
<tr>
<td>Gunderman, 2000</td>
<td>Survey† 181/266 (RR 68%) Paediatricians (general, subspec, staff and resident) General questions</td>
<td>Content: Examination quality, description, differential diagnosis, diagnosis, clinical correlation, comparison, recommendations, completeness Clarity and certainty Accuracy</td>
</tr>
<tr>
<td>Heikkinen, 2000</td>
<td>Observational study (Audit) 400 CT reports †,§ 100 random from studies describing liver, kidney or spleen lesions from each of 4 hospitals</td>
<td>Content§: Technique, Description, quality, clinical correlation, comparison, diagnosis, differential diagnosis, recommendations Language Format</td>
</tr>
<tr>
<td>Hessel, 1975</td>
<td>i) Observational study 400 reports generated prospectively from 100 randomly selected CXR by 8 radiologists/residents compared to consensus “final report” ii)Survey 25 physicians 6 paired reports differing in one element of “communication value”</td>
<td>Accuracy Content: Description, Diagnosis, Conclusion, Clinical correlation, Conclusion Language Format</td>
</tr>
<tr>
<td>Hobby, 2000</td>
<td>Survey 11 readers(radiologists, orthopaedic surgeons, rheumatologists) 18 commonly used expressions describing probability identified from report review plotted on visual analogue scale Re-tested 4 occasions at least 1 week apart</td>
<td>Language</td>
</tr>
<tr>
<td>Houssami, 2007</td>
<td>Observational study (Audit)</td>
<td></td>
</tr>
<tr>
<td>Johnson, 2004</td>
<td>Survey† 168/725 (RR=23%) eligible physicians at one institution Medicine, subspecialties, radiology, unknown General questions, anonymous responses</td>
<td>Content: Description, completeness Accuracy Clarity and Certainty Format</td>
</tr>
<tr>
<td>Khorasani, 2003</td>
<td>Survey† 15 most commonly identified expressions for certainty from radiologist interviews List ranked by 34/45 clinical specialities (RR76%) staff radiologists, 78/158(RR49%)</td>
<td>Language</td>
</tr>
<tr>
<td>Lafortune, 1988</td>
<td>Survey†104/200 doctors Primary care practitioners, surgeons, internists</td>
<td>Content: Clinical correlation, technique, examination quality, reactions, description, long differential diagnosis ,</td>
</tr>
<tr>
<td>Authors, Year</td>
<td>Methods</td>
<td>Attributes</td>
</tr>
<tr>
<td>--------------------</td>
<td>-------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>General Questions</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>recommendations, Clarity and Certainty, Language, Format</td>
</tr>
<tr>
<td>Lee, 2006</td>
<td>Observational study: Retrospective 240/365 randomly selected intensive care admission CXR reports, exclusion usually because not admission</td>
<td>Content: Clinical correlation, conclusion</td>
</tr>
<tr>
<td>McLoughlin, 1995</td>
<td>Survey† 77/100 most frequent CXR/Abdominal US referrers (RR77%)</td>
<td>Content items: History, Description</td>
</tr>
<tr>
<td></td>
<td>General and Subspec Internists, Surgeons, primary care, ED, paediatrics, obstetrics and gynaecology</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sample reports: CXR (screening for “weakness” and normal findings, cough and fever and normal findings, cough and fever and pneumonia, dyspnoea and congestive heart failure) and Abdo US (RUQ, pain and normal findings, RUQ, pain and gallstones)</td>
<td></td>
</tr>
<tr>
<td>Naik, 2001</td>
<td>i) Observational study (Audit) 272 random US, CT, mammo, fluoroscopy, plain radiographs</td>
<td>Content items: History, technique, quality, comparison, description, recommendations, conclusion</td>
</tr>
<tr>
<td></td>
<td>ii) Survey 195/145 (RR 52%) internal medicine, surgery, ED, obstetrics and gynaecology, ED, primary practice, critical care, 0-5 US reports/week and 25 radiologists at interactive form with additional questions</td>
<td>Format</td>
</tr>
<tr>
<td></td>
<td>General questions</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sample reports: Abdominal US (RUQ, pain and normal findings, Follow-up AAA and incidental renal mass), Pelvic US (painless mass and probable endometrioma)</td>
<td></td>
</tr>
<tr>
<td>Plumb, 2009</td>
<td>Survey† 49/99 (RR 49%) hospital US referrers: medicine, surgery and subspecialties, anaesthesia and ICU, trauma, reading average of 15 reports/week</td>
<td>Content: History, Technique, Examination quality, Description, recommendations, conclusion</td>
</tr>
<tr>
<td></td>
<td>General Questions</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sample report preferences (normal abdominal ultrasound for right upper quadrant pain ?gallstones and abnormal abdominal ultrasound for weight loss ?malignancy)</td>
<td>Format</td>
</tr>
<tr>
<td>Sierra, 1992</td>
<td>Observational study retrospective 10,361 consecutive reports general radiology, mammography, ultrasound, MRI</td>
<td>Clarity</td>
</tr>
<tr>
<td></td>
<td>40 randomly selected CXR reports from sample reviewed by 11 primary care practitioners</td>
<td>Certainty/confidence</td>
</tr>
<tr>
<td>Sistrom/Honeyman-Buck, 2005</td>
<td>i) Non-blinded randomised controlled trial 16 medical students reviewing 12 purposefully selected reports (4 Abdo CT, 4 Head CT, 4 Abdo US) describing unusual, unexpected, emergent findings randomised to structured or prose format versions</td>
<td>Certainty</td>
</tr>
<tr>
<td></td>
<td>ii) Post-experiment survey and focus group 15/16 subjects: general questions</td>
<td>Language</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Format</td>
</tr>
<tr>
<td>Sistrom/</td>
<td>Narrative review</td>
<td>Content: Completeness</td>
</tr>
</tbody>
</table>

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Appendix 2: Literature Review

<table>
<thead>
<tr>
<th>Authors, Year</th>
<th>Methods</th>
<th>Attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Langlotz, 2005</td>
<td>Language</td>
<td>Language</td>
</tr>
<tr>
<td>Sobel, 1996</td>
<td>Observational study (Audit) 822 CXR representative sample patients 65+ years with admission diagnosis of congestive heart failure, myocardial infarction, pneumonia, exclusions because no day 1,2 CXR report or illegible report</td>
<td>Content items: Technique, quality, description, comparison</td>
</tr>
<tr>
<td>Stavem, 2004</td>
<td>Observational study (Audit) 148 reports randomly selected from 293 consecutive examinations CT, ultrasound, CXR, AXR</td>
<td>Proofreading</td>
</tr>
</tbody>
</table>

* Reports in Dutch and Flemish
† Instrument or detailed description included in paper
‡ Reports in Finnish, English
§ Based partly on ACR standard
|| Audit items based on BIRADS, Australian national recommendations and local criteria
¶ Reports in Norwegian

Table V: Existing Guidelines – report attributes addressed by the guidelines

<table>
<thead>
<tr>
<th>Attribute/ Guideline</th>
<th>ACR</th>
<th>CAR</th>
<th>RCR</th>
<th>SIR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Content: History</td>
<td>Relevant information</td>
<td>Unless request accessible</td>
<td>Pre-procedure</td>
<td></td>
</tr>
<tr>
<td>Content: Technique</td>
<td>Procedures and materials</td>
<td>Procedures and materials</td>
<td>Procedures, materials, results</td>
<td></td>
</tr>
<tr>
<td>Content: Exam Quality</td>
<td>Factors compromising</td>
<td>Limitations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Content: Description</td>
<td>Appropriate</td>
<td>Precise</td>
<td>“Of findings”</td>
<td>Results/findings</td>
</tr>
<tr>
<td>Content: Comparison</td>
<td>When appropriate</td>
<td>Can be in conclusion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Content: Diagnosis</td>
<td>Precise when possible</td>
<td>Precise when possible</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Content: Differential</td>
<td>When appropriate</td>
<td>When appropriate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Content: Clinical correlation/ answering the clinical question</td>
<td>Should address/answer</td>
<td>Should address/answer</td>
<td>Should answer</td>
<td></td>
</tr>
<tr>
<td>Content: Recommendations</td>
<td>When appropriate</td>
<td>When appropriate</td>
<td>Post-procedure plan</td>
<td></td>
</tr>
<tr>
<td>Content: Conclusions</td>
<td>Unless report brief, including recommendations, reactions</td>
<td>Unless brief or stable recent comparison</td>
<td>In clinical context</td>
<td>In final report</td>
</tr>
</tbody>
</table>

Accuracy

Clarity and Certainty

Language

Format

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APPENDIX 3 - Conflict of Interest

CONFLICT OF INTEREST

DISCLOSURE DECLARATION

NAME: 
NAME OF PANEL: Radiology Written Report Guidelines Project 
Multi-disciplinary Advisory Panel 
DATE: 

If members of this Panel have any interests which they believe could be regarded as a conflict of interest or as influencing their advice or perspective, they should declare them below.

<table>
<thead>
<tr>
<th>Current Interests</th>
<th>Industry/organisation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>Description</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Non-Current Interests</th>
<th>Industry/organisation</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Previous 12 Months Or Planned Over Next 12 Months)</td>
<td></td>
</tr>
<tr>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>Description</td>
<td></td>
</tr>
</tbody>
</table>

I declare the above current, previous and planned interests.

Signature: .................................................................

OR

I declare that I do not have any current, previous or planned interests which I believe could be regarded as a conflict of interest or as influencing my advice or perspective.

Signature: .................................................................

If you have any queries about completing this form please contact Jane Grimm on 02 9268 9719.
APPENDIX 4 - Advisory Panel Members:

1. **Chair:**
   A/Prof. Stacy Goergen
   Director of Research,
   Department of Diagnostic Imaging,
   Monash Medical Centre
   
   *Clinical Advisor, RANZCR Quality Use of Diagnostic Imaging Program*

2. **Content expert:**
   Dr Felicity Pool
   Radiologist

3. **Consumer representative:**
   Ms Ann Revell
   Indepent Consumer Representative

4. **Private practice radiologist:**
   Dr Richard Perry
   Radiologist
   PRP Diagnostic Imaging

5. **Public sector radiologist:**
   Dr Nick Ferris
   Radiologist
   Peter MacCallum Cancer Centre

6. **Chief Censor and Chair, Curriculum Advisory Committee, RANZCR:**
   Professor Shih-Chang (Ming) Wang
   Professor of Radiology
   University of Sydney

7. **Corporate Radiology:**
   Dr Chris Wriedt
   Medical Director
   IMED – MIA

8. **Referrer - GP:**
   Prof Grant Russell
   Director, Southern Academic Primary Care Research Unit
   Monash University

9. **Referrer - Oncology:**
   Dr Michael Fay
   Radiation Oncologist
   Royal Brisbane and Women’s Hospital

10. **Referrer - Emergency Medicine:**
    Dr Carmel Crock
    Emergency Medicine Physician
    Royal Victorian Eye and Ear Hospital
11. **Referrer - Surgeon:**
   Dr Sue Liew  
   Spinal Surgeon  
   Royal Children's Hospital, Melbourne

12. **Referrer - Paediatrician**
   Dr Michael Fahey  
   Paediatric Neurologist  
   SouthernHealth

13. **Referrer - Physician**
   Dr Mark Appleyard  
   Gastroenterologist  
   Royal Brisbane and Women’s Hospital

14. **DoHA representative**
   Dr Megan Keaney  
   Medical Officer  
   Medical Benefits Division, Department of Health and Ageing

15. **Guideline development expert:**
   Dr Tari Turner  
   Senior Research Fellow  
   National Trauma Research Institute, Monash University

The advisory panel was supported by project management and a secretariat to manage meeting arrangements, distribution of documents, production of guideline drafts, and publication / communication / dissemination of the final document.

- **Copy editor:**
  Ms Charlotte Bolcskey (freelance from JMIRO)

- **Project Management:**
  Ms Jane Grimm  
  Director, Quality and Standards of Practice, RANZCR

- **Communication:**
  Ms Pamela Taylor  
  Director, Communications and Membership, RANZCR

- **RANZCR Standards of Practice:**
  Ms Lisa Penlington  
  Manager, Quality and Accreditation, RANZCR
APPENDIX 5 - Example Report templates

Two sample templates have been included in this guideline document as examples of templates currently used in a number of centres around Australia.

The first is a template for reporting of diagnostic / screening breast MRI studies. It has been provided by Dr Alison Rose, Royal Melbourne Hospital. It was adapted from a template developed by the American College of Radiology.

The second has been developed by Dr Kirsten Gormly, a consultant radiologist at the Tennyson Centre, a private oncology day hospital and at the Royal Adelaide Hospital, and has been designed for reporting MRI studies for staging of rectal cancer.

These templates have not been developed for this guideline, but are provided as illustrative examples of disease-specific report templates.
# MRI Breast Report Template

**Case Number:**

**Parenchymal Volume:**
- <25%
- 25-50%
- 50-75%
- >75%

**Background Parenchymal Enhancement:**
- minimal
- mild
- moderate
- marked

<table>
<thead>
<tr>
<th>Side</th>
<th>R</th>
<th>L</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Quadrant</strong></td>
<td>LOQ</td>
<td>UOQ</td>
</tr>
<tr>
<td><strong>Depth</strong></td>
<td>ant third</td>
<td>mid third</td>
</tr>
<tr>
<td><strong>Lesion Type</strong></td>
<td>Focus</td>
<td></td>
</tr>
<tr>
<td><strong>Mass</strong></td>
<td>single</td>
<td>multiple similar</td>
</tr>
<tr>
<td>T1</td>
<td>hypo</td>
<td>hyper</td>
</tr>
<tr>
<td>T2</td>
<td>hypo</td>
<td>hyper</td>
</tr>
<tr>
<td><strong>Shape (select one)</strong></td>
<td>round</td>
<td>oval</td>
</tr>
<tr>
<td><strong>Margin (select one)</strong></td>
<td>smooth</td>
<td>irregular</td>
</tr>
<tr>
<td><strong>Enhancement Pattern (select one)</strong></td>
<td>homogeneous</td>
<td>heterogeneous</td>
</tr>
<tr>
<td><strong>Kinetics</strong></td>
<td>Initial:</td>
<td>slow</td>
</tr>
<tr>
<td>Delayed: (choose one most suspicious)</td>
<td>persistent</td>
<td>plateau</td>
</tr>
<tr>
<td><strong>Non-Mass Distribution (select one)</strong></td>
<td>linear</td>
<td>segmental</td>
</tr>
<tr>
<td>focal area</td>
<td>ductal</td>
<td></td>
</tr>
<tr>
<td>regional</td>
<td>multiple regions</td>
<td></td>
</tr>
<tr>
<td>diffuse</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Internal Enhancement pattern (select one)</strong></td>
<td>homogenous</td>
<td>heterogeneous</td>
</tr>
<tr>
<td><strong>Symmetry</strong></td>
<td>Symmetrical</td>
<td>Asymmetrical</td>
</tr>
<tr>
<td><strong>Associated findings</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R</td>
<td>L</td>
<td></td>
</tr>
<tr>
<td>None apply</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nipple retraction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nipple invasion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-contrast high ductal signal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skin thickening (focal)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skin thickening (diffuse)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skin Invasion</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>BiRADS Assessment (select one per breast)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R</td>
<td>L</td>
<td></td>
</tr>
<tr>
<td>0=Technical Issues</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1=Negative/Normal - Routine F/up</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2=Benign - Routine F/up</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3=Probably benign - Early review</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4=Suspicious - Biopsy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5=Highly Suspicious - Biopsy &amp; appropriate action</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6=Known biopsy-proven cancer</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Lesion 2**

<table>
<thead>
<tr>
<th>Side</th>
<th>R</th>
<th>L</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Quadrant</strong></td>
<td>LOQ</td>
<td>UOQ</td>
</tr>
<tr>
<td><strong>Depth</strong></td>
<td>ant third</td>
<td>mid third</td>
</tr>
<tr>
<td><strong>Focus</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Mass</strong></td>
<td>single</td>
<td>multiple similar</td>
</tr>
<tr>
<td>T1</td>
<td>hypo</td>
<td>hyper</td>
</tr>
<tr>
<td>T2</td>
<td>hypo</td>
<td>hyper</td>
</tr>
<tr>
<td><strong>Shape (select one)</strong></td>
<td>round</td>
<td>oval</td>
</tr>
<tr>
<td><strong>Margin (select one)</strong></td>
<td>smooth</td>
<td>irregular</td>
</tr>
<tr>
<td><strong>Enhancement Pattern (select one)</strong></td>
<td>homogeneous</td>
<td>heterogeneous</td>
</tr>
<tr>
<td><strong>Kinetics</strong></td>
<td>Initial:</td>
<td>slow</td>
</tr>
<tr>
<td>Delayed: (choose one most suspicious)</td>
<td>persistent</td>
<td>plateau</td>
</tr>
<tr>
<td><strong>Non-Mass Distribution (select one)</strong></td>
<td>linear</td>
<td>segmental</td>
</tr>
<tr>
<td>focal area</td>
<td>ductal</td>
<td></td>
</tr>
<tr>
<td>regional</td>
<td>multiple regions</td>
<td></td>
</tr>
<tr>
<td>diffuse</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Internal Enhancement pattern (select one)</strong></td>
<td>homogenous</td>
<td>heterogeneous</td>
</tr>
<tr>
<td><strong>Symmetry</strong></td>
<td>Symmetrical</td>
<td>Asymmetrical</td>
</tr>
<tr>
<td><strong>Symmetry</strong></td>
<td>Symmetrical</td>
<td>Asymmetrical</td>
</tr>
<tr>
<td><strong>Notes:</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
MRI pelvis (rectal cancer)

<table>
<thead>
<tr>
<th>Primary tumour:</th>
<th>annular</th>
<th>ulcerating</th>
<th>polypoidal</th>
<th>villous</th>
<th>eroding</th>
<th>mucinous</th>
<th>signet</th>
<th>not easily shown</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height from anal verge:</td>
<td>mm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distal edge of tumour lies:</td>
<td>at/below the puborectalis sling</td>
<td>mm</td>
<td>above PR sling</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extends craniocaudally over:</td>
<td>mm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lies:</td>
<td>mm</td>
<td>above peritoneal reflect'n</td>
<td>below peritoneal reflect'n</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Invading edge of tumour:</td>
<td>from</td>
<td>o'clock</td>
<td>to</td>
<td>o'clock</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muscularis propria:</td>
<td>confined to</td>
<td>extends through</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extramural spread:</td>
<td>mm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T stage:</td>
<td>T1</td>
<td>T2</td>
<td>T3a</td>
<td>T3b</td>
<td>T3c</td>
<td>T3d</td>
<td>T4a</td>
<td>T4b</td>
</tr>
<tr>
<td>Locally, tumour extends:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Malignant lymph nodes:
- At level of tumour: none | present number | mixed signal/irregular border
- Above level of tumour: none | present number | mixed signal/irregular border

Extramural venous invasion:
- no evidence | evidence | small | medium | large

Closest circumferential resection margin:
- o'clock

Minimum tumour distance to mesorectal fascia:
- mm, CRM clear | CRM involved

Closest CRM lies at distance from anal verge:
- mm

Peritoneal involvement:
- no evidence | evidence

Pelvic side wall lymph nodes:
- none | benign | malignant

Summary:
- Overall stage: T | N | CRM clear | CRM involved | EMVI positive | EMVI negative | M0 | M1 | good prognosis | poor prognosis

By imaging criteria, eligible for:

Discussion points for imaging case: