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Title:
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Date:
2022-08-01

Citation:
Preece, E., Whitchurch, M. & Sutherland, T. (2022). Verbal notification of radiology results: are radiologists meeting expectations?. Internal Medicine Journal, 52 (8), pp.1402-1408. https://doi.org/10.1111/imj.15373.

Persistent Link:
https://hdl.handle.net/11343/311027

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This is the author manuscript accepted for publication and has undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the Version of Record. Please cite this article as doi: 10.1111/imj.15373

Verbal Notification of Radiology Results: Are radiologists meeting expectations?

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Introduction

This study aims to analyse the clinical practice of radiologists and the preferences of referring practitioners in the communication of radiological findings. These two groups were compared to assess difference in practice and expectations, with subset analysis of results in relation to clinical experience and individual question responses.

Radiological examinations increasingly guide patient diagnosis and management through their findings.[2] Effective communication of these findings is required for the provision of prompt medical care, and to prevent missed diagnoses.[4,5,6] Despite this need, systematic reviews have shown a lack of follow-up of 20 to 62% of inpatient pathology and imaging results.[7] Verbal notification by radiologists of important results is one method of mitigating the sometimes disastrous effect[8] of missed or delayed results[9] with the Royal Australian and New Zealand College of Radiologists (RANZCR) recently publishing guidelines to this effect in August 2019.[10]

The impact of this guideline on Australian practice is yet to be seen, however the American College of Radiology's similar guideline published in 1991 heralded significant discussion of notification methods and the radiologist's legal responsibility of notification.[5,10,11,12,13] A common issue with such guidelines is the broad definition of findings warranting urgent notification.[14,15] The radiologist will be aware of the natural history of a condition but will have limited information about the patient and

their clinical situation and functional status. The referring doctor has access to this information but may have limited understanding of the significance of radiological findings, especially when it is an incidental finding that falls outside their specialty. We aim to assess differences in radiologist practice and referring practitioners' expectations regarding verbal notification of findings, to improve communication between teams and ultimately optimise patient safety.

Methods

A survey comprising 33 questions (Appendix 1) was created by the study authors comprising a short clinical stem and a summary of findings. Questions were designed in groups to have identical findings with slightly different clinical stems, or identical stems with slightly different findings. These questions were then randomly distributed through the survey. The survey also collected data regarding the participants demographics such as level of seniority and department.

Online surveys were distributed via staff internal email utilising the Typeform survey platform at a single tertiary centre in Victoria, Australia. All responses were anonymous, with survey enrolment only establishing the participant's clinical role and level of experience. Participants were then provided with the survey and asked to respond whether they would expect (for referring practitioners) or issue (for radiologists) verbal notification of the relevant findings.

Statistical Analyses

Results were analysed using IBM SPSS Version 26.0 for Windows (SPSS Inc., Chicago, Ill, USA). Response rates were examined as percentages with 95% confidence intervals (95CI). Pearson Chi-square and Fleiss' Kappa values were calculated to examine significant differences and overall level of agreement, respectively. P values <0.05 were regarded as significant.

Ethics Approval

This study was approved by St Vincent's Hospital Melbourne Human Research Ethics Committee (reference QA 035/16).

Results

Response rate and sample characteristics

A total of 97 survey responses were received (Table 1), 17 from radiologists (10 registrars and fellows, 7 consultants) and 80 from non-radiology medical staff (23 interns and residents, 15 registrars and fellows, 42 consultants). The centre at which the survey was conducted employs 20 consultant radiologists including visiting medical officers (7/20, 35% response rate) and 12 radiology registrars (10/12, 83% response rate). The study site does not employ radiology residents or unaccredited registrars.

Overall results (Table 2) show close correlation between referring clinician's expectation of verbal notification in 61% (95CI 57-66%) of scenarios overall, and radiologists issuing verbal notification in 58% (95CI 52-64%). Fleiss' kappa for inter-rater reliability was 0.24, indicating fair agreement. Stratifying results by level of experience demonstrated a trend of more experienced referring practitioners having an increased preference towards verbal notification. Clinicians with >10 years' experience expected notification in 67% of cases (95CI 59-75%), consultants of 5-10 years' experience in 68% (95CI 53-84%), consultants of <5 years' experience in 63% (95CI 51-74%), and registrars and fellows expected notification in 59% of cases (95CI 43-76%). Referring residents had the lowest expectation of notification at 55% overall (95CI 45-64%).

Analysis of radiologists stratified by level of clinical experience is limited, given only 17 respondents were included in this study. Overall trends suggest a decreasing rate of verbal notification as radiologist clinical experience increased, although this data did not reach statistical significance.

Regarding specific clinical scenarios and their responses, results are quoted as "referrer notification expectation percentage / radiologist call percentage / overall notification percentage".

A finding of pulmonary emboli was consistently verbally notified (89% / 91% / 89%). This did not change when it was the suspected diagnosis (Questions 5 and 13: 90% / 85% / 89%) or an unexpected incidental finding (Question 27: 88% / 100% / 90%). Likewise, the verbal notification of intracranial haemorrhage was consistently given and expected (88% / 84% / 87%). This rate remained high in bleeds of varying chronicity and across clinical settings, including at home (Questions 11 and 31: 84% / 79% / 83%) and after a fall in hospital (Question 19: 95% / 94% / 95%).

Both referrers and radiologists were more likely to expect verbal communication for a pathologic fracture (Question 15: 64% / 71% / 65%) compared with a simple fracture (Question 1: 53% / 29% / 49%).

Chest x-ray findings of uncomplicated pneumonia were seldom verbally notified (Question 12: 21% / 18% / 21%), while features suspicious for tuberculosis were frequently communicated (Question 4: 81% / 88% / 83%). Latent tuberculosis in a patient being considered for anti-TNF therapy had lower overall notification rates (Question 21: 39% / 41% / 39%) in comparison.

An incidental 4cm abdominal aortic aneurysm did not have significantly different notification rates, regardless of whether this finding was seen in a 57 year old (Question 7: 39% / 29% / 37%) or an 81 year old (Question 17: 31% / 12% / 28%).

Significant differences were seen regarding the incidental finding of a large thyroid nodule on MRI spine, with referring practitioners preferring notification more often than provided (Question 30: 34% / 0% / 28%, p=0.005). Similarly, a likely diagnosis of lymphoma was expected to be notified by clinicians more often than provided by radiologists (Question 8: 71% / 41% / 66%, p=0.017), although in patients suspected of having renal tract malignancy and obstructing transitional cell carcinoma was more likely to generate a radiologist phone call (Question 16: 65% / 59% / 64%). These rates of notification more closely correlated with the rates of notification for hydronephrosis in the setting of a ureteric stone (Question 25: 59% / 82% / 63%).

In patients undergoing surveillance for previous colorectal cancer there were no differences in verbal notification rates between recurrent tumour (Question 14: 49% / 41% / 47%) or a new primary tumour (Question 6: 51% / 47% / 51%). The incidental finding of a renal neoplasm had higher verbal reporting rates when detected on CT colonography (Question 2: 80% / 77% / 79%) in comparison. Response rates by question are seen in Figure 2.

Discussion

Communication in modern medicine is vital to patient care. Modern radiology information systems can provide reports by email or directly to electronic medical records, however these processes, while efficient, do not guarantee that the report will be read or acted upon in a timely manner. There is no doubt that the radiologist has a responsibility to patient care[17] and although they are expected to call with urgent findings, the definition of urgent is open to interpretation. Studies have also shown that many reports are never read[4,5,6,18,19] and so important but non-urgent findings that are not verbally notified may go unmanaged by the referring doctor.

Our study intended to assess the correlation between radiologists and referring doctors regarding when an imaging finding should be communicated verbally. We found a fair correlation between the overall expectations of referring doctors and the reporting radiologists regarding notification.

There are clearly several factors that radiologists consider when deciding if a verbal call is required. High rates of verbal communication were seen for conditions that were potentially rapidly life threatening such as intracranial haemorrhage and pulmonary embolism. Notifying for some of these conditions may have become so ingrained during radiology training that they persist for related but less urgent conditions, given we found no significant difference between call rates for acute subdural haemorrhage and subacute to chronic subdural haemorrhage. Abdominal free gas, similarly, was verbally notified by all radiologists regardless of whether the patient was acutely post-operative or had a virgin abdomen.

Rates of notification were independent of whether the finding was expected or incidental if the condition was potentially rapidly life threatening, as demonstrated by the high call rates for pulmonary embolism regardless of the clinical scenario. However, conditions which are important but not immediately life threatening were less likely to be called, which may relate to an expectation that the radiologist has time to generate a formal written report and the referring doctor has time to read the report. This was demonstrated by the relatively low notification rates for findings of suspected, recurrent, or new tumours. While we did find higher rates of notification for a question detailing an obstructing ureteric tumour, response rates more closely correlated to call rates for stone related hydronephrosis, rather than new tumour notification. This may be due to the more urgent possibility of sepsis or impaired renal function due to this hydronephrosis, rather than any clinical urgency inherent to the tumour diagnosis. Higher rates of verbal notification of tumours was seen when found incidentally during CT colonography rather than as part of oncology surveillance, potentially due to

expectations that oncology patients have more regular follow up and hence are more likely to attend to receive investigation results.

The age of a patient did not appear to be a significant factor as demonstrated with the similar rates of notification for the incidental finding of an abdominal aortic aneurysm. This may be related to the limited clinical information provided to radiologists not allowing accurate assessment of the patient's comorbidities or ECOG status, and subsequently a reduced ability to judge the clinical relevance of findings for any individual patient.

A significant difference between radiologist and referrer preferences was seen regarding an incidental thyroid nodule found on MRI cervical spine, with no radiologists verbally notifying but a third of practitioners expecting notification (34% vs 0%, p=0.005). Incidental thyroid nodules are a common imaging finding seen in 1 in 6 patients undergoing CT and MR examinations of the neck,[20] with the majority being benign or indolent in nature and suitable for non-urgent investigation.[21,22] While radiologists are likely to be exposed to the high incidence and low malignant potential of these incidental thyroid lesions during their practice, our sample of referring clinicians from varied fields may have been unfamiliar with head and neck imaging findings and their significance. This information gap may have contributed to this difference in notification preferences, with some radiology departments abroad seeking to address this gap through the addition of a standardised information box to reports including thyroid nodules, [22,23] similar to interpretation aides seen on some pathology reports.

Overall trends suggested more senior referring practitioners expected verbal notification more often, while more senior radiologists provided verbal notification less often.

The finding of senior radiologists verbally notifying less often is similar to earlier research which found reduced calls for follow-up imaging as radiologist experience increased,[24] attributed to a decrease in the tendency to 'overcall' uncertain findings. A similar mechanism may account for the trend of reduced rates of verbal notification in more senior radiologists observed in our data.

Of interest is the higher rate of preferred notification seen in more senior referring clinicians. Given the high rates of test results that are not reviewed,[4,5,6,19] it is not surprising that senior practitioners, often balancing practice across multiple clinical sites, may rely on verbal notification of results. Routine review of reports or notifications through a computerised system is challenging when a practitioner is working off-site, and earlier research has demonstrated poor rates of timely follow-up for electronic alerts overall.[8] As such, more senior consultants may prefer verbal reports, even in more uncertain clinical scenarios, to mitigate the difficulty of routinely reviewing written reports of varying significance.

RecommendationsWhile our results otherwise show fair correlation, we have demonstrated some discrepancies in the verbal notification of results. In an effort to address these discrepancies, the RANZCR published their Critical Test Result Notification Position Statement in 2019.[10] This statement recommends that "critical findings, adverse events and adverse outcomes" are conveyed in a "clinically appropriate timeframe",[10] and our findings suggest this definition may have different

meanings to referring practitioners and reporting radiologists of varying seniority and in certain scenarios. For this reason, the RANZCR does not provide a list of notifiable conditions but rather provides a framework and suggests development of local practice guidelines.

Similar documents published overseas have led to significant discussion around what expectations are placed upon radiologists in communicating results.[5,11,12,13,14] The authors feel there are similar discussions surrounding the RANZCR position statement, and that radiologists and referring practitioners must continue to foster a constructive relationship regarding the communication of emergent imaging findings. While guidelines offer some framework, they are generally inflexible and do not adapt to the significance of findings for individual patients. Fostering a working relationship between referring practitioners and radiologists is vital to produce a practical solution with all parties sharing responsibility for effective communication.

To improve the recognition of significant findings requiring notification, we suggest the continued emphasis of these findings throughout doctor-in-training pathways. In addition, referring practitioners should take note of the often sparse 'clinical details' section of the radiology request form,[25] with adequate histories and clinical questions shown to improve diagnostic accuracy and frame the urgency of any imaging findings.[26] Ongoing assessment of radiologist and referring practitioner expectations, for example through regular audit of verbal notification practices, will also improve the communication of urgent findings and reduce over-notification. Our survey and results could be used as a tool to lead local discussion and development of regional guidelines tailored to individual radiology department reporting practices, and further improve the working relationship between referring practitioners and the increasing utilised service of diagnostic radiology.

A limitation of our study is that we have not qualitatively assessed which factors influence verbal reports. From experience extrinsic factors do exert an influence, such as competing workload demands and difficulty contacting the referring doctor. The time involved in providing and receiving verbal reports competes against the ever-increasing workload. For this reason, electronic alert systems have been implemented to alert referrers when an important result is available and to provide a read receipt to the radiologist once the report has been read. These systems ideally will reduce the number of calls that need to be made and received and will hopefully reduce communication errors. However, many practitioners may still prefer verbal notification of urgent imaging findings due to advantages of notification speed, certainty of receipt, and the options of clarification and closed loop communication of results as required. An assessment of referring practitioner preferences towards electronic notification systems was not attempted in our limited survey but may provide further guidance in hospital implementation of effective notification systems and guidelines.

A further limitation of this study was our modest sample size, particular of radiologist respondents. While referring clinicians were enrolled from various departments, our radiologist study population was limited by the number of radiologists employed at the single tertiary centre hospital assessed. While our findings reflect the practices of this particular radiology department, a large multi-centre survey involving multiple radiology departments would be required to assess prevailing reporting practices. Another unmeasurable variable when collecting data in an observed survey is the Hawthorne effect. This states that the responders, aware that their responses would be analysed, may

alter their responses and behaviour in the survey to represent ‘ideal world’ as opposed to the ‘real world’ of busy practice, and may have influenced our results.

Conclusion

Improving the practice of urgent result notification to be more in line with referring practitioners’ expectations is necessary for effective medical practice. Missed or delayed findings attract considerable morbidity, mortality, and medicolegal consequence. Methods of improving notification systems, as well as any shortcomings identified, are likely to attract considerable attention given the recent publication of the 2019 RANZCR Critical Test Result Notification Statement. While our results show that overall practitioner and radiologist expectations correlate well regarding which findings warrant urgent notification, some discrepancies exist.

To address these discrepancies, we suggest the continued emphasis on the clinical relevance of findings in doctor-in-training pathways, as well as the implementation and encouragement of effective feedback systems between referring practitioners and radiologists. The continued development of effective clinical relationships and implementation of relevant local guidelines is essential for minimising patient harm from the delayed notification of important results.

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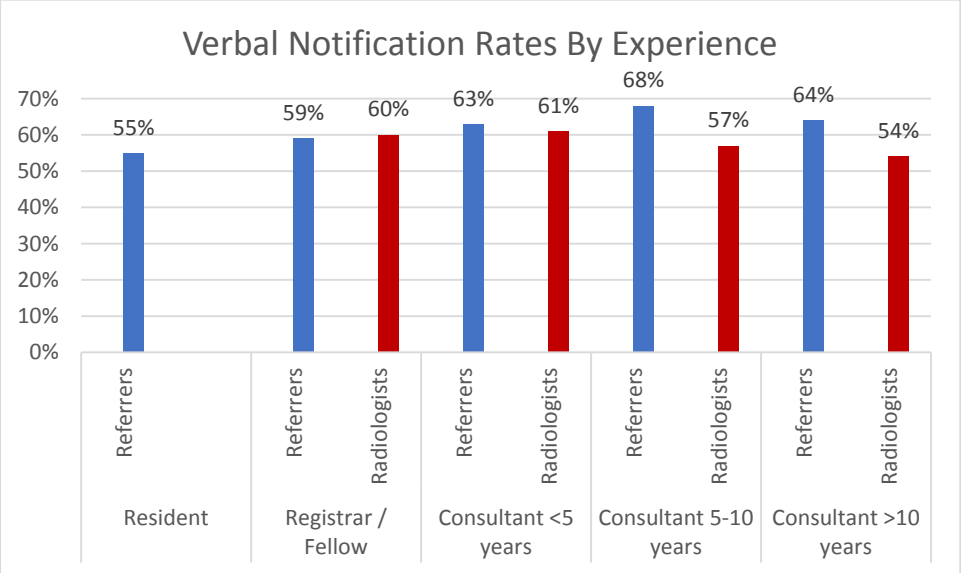
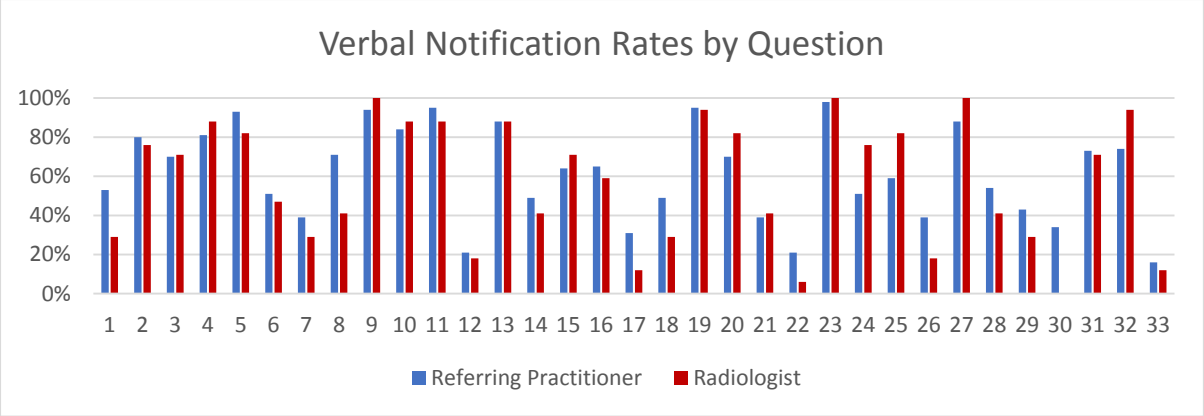
Table 1 – Results and Survey Respondents

Experience	**Role**		Verbal Notification	Written Report Only	Total
Resident	Referring Practitioner (n=23)	Responses	415	344	759
		%	55% (95CI 45-64%)	45% (95CI 36-55%)	100%
Registrar / Fellow	Referring Practitioner (n=15)	Responses	293	202	495
		%	59% (95CI 43-76%)	41% (95CI 25-57%)	100%
	Radiologist (n=10)	Responses	196	134	330
		%	60% (95CI 50-70%)	40% (95CI 31-50%)	100%
Consultant <5 years	Referring Practitioner (n=10)	Responses	206	124	330
		%	63% (95CI 51-74%)	38% (95CI 26-49%)	100%
		Responses	20	13	33

	Radiologist (n=1)	%	61% (95CI N/A)	39% (95CI N/A)	100%
Consultant 5-10 years	Referring Practitioner (n=6)	Responses	135	63	198
		%	68% (95CI 53-84%)	32% (95CI 16-47%)	100%
	Radiologist (n=2)	Responses	37	29	66
		%	57% (95CI 37-76%)	44% (95CI 24-63%)	100%
Consultant >10 years	Referring Practitioner (n=26)	Responses	573	285	858
		%	67% (95CI 59-75%)	33% (95CI 25-41%)	100%
	Radiologist (n=4)	Responses	71	61	132
		%	54% (95CI 39-69%)	46% (95CI 31-61%)	100%
Total	Referring Practitioner (n=80)	Responses	1721	1018	2739
		%	61% (95CI 57-66%)	39% (95CI 34-43%)	100%
	Radiologist (n=17)	Responses	324	237	561
		%	58% (95CI 52-64%)	42% (95CI 36-48%)	100%





Abstract

Background:

Delayed communication of radiographic findings is associated with poor patient outcomes and significant medicolegal risk. Radiologists verbally contact referring practitioners with urgent findings, though practitioner's expectations regarding notification has rarely been examined.

Aim:

To assess differences in preferred practice between radiologists and referring practitioners in the verbal communication of urgent radiology findings.

Methods:

For 33 clinical stems, respondents were asked if they would issue (radiologists) or expect to receive (referring practitioners) verbal notification of results or routine written communication only. Surveys were emailed to radiologists and referring practitioners of varying experience at a tertiary referral hospital in Melbourne, Victoria.

Results:

A total of 97 survey responses were received. 80 responses were from referring practitioners and 17 from radiologists. Referring practitioners were seen to slightly prefer verbal notification more often than issued by radiologists overall (61%; 95CI 57-66% verbal notification expected versus 58%; 95CI 52-64% issued). More senior referring practitioners with greater than 10 years' experience expected verbal notification more often (67%; 95CI 59-75%), and more senior radiologists issued verbal reports less often (54%; 95CI 39-69%). More junior referring practitioners, for example registrars or fellows, expected notification less often overall (59%; 95CI 43-76%). Subgroup analysis demonstrated statistically significant differences in notification preferences for certain clinical scenarios.

Conclusions:

Overall results show fair correlation between referrer's expectations of verbal notification and the provision of verbal notification by radiologists. However, there were discrepancies in the practice and preferences of more junior and senior practitioners, in addition to in certain clinical scenarios.

Keywords:

Radiology, communication, information technology, diagnostic imaging, diagnostic tests and procedures

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Introduction

This study aims to analyse the clinical practice of radiologists and the preferences of referring practitioners in the communication of radiological findings. These two groups were compared to assess difference in practice and expectations, with subset analysis of results in relation to clinical experience and individual question responses.

Radiological examinations increasingly guide patient diagnosis and management through their findings.[2] Effective communication of these findings is required for the provision of prompt medical care, and to prevent missed diagnoses.[4,5,6] Despite this need, systematic reviews have shown a lack of follow-up of 20 to 62% of inpatient pathology and imaging results.[7] Verbal notification by radiologists of important results is one method of mitigating the sometimes disastrous effect[8] of missed or delayed results[9] with the Royal Australian and New Zealand College of Radiologists (RANZCR) recently publishing guidelines to this effect in August 2019.[10]

The impact of this guideline on Australian practice is yet to be seen, however the American College of Radiology's similar guideline published in 1991 heralded significant discussion of notification methods and the radiologist's legal responsibility of notification.[5,10,11,12,13] A common issue with such guidelines is the broad definition of findings warranting urgent notification.[14.15] The radiologist will be aware of the natural history of a condition but will have limited information about the patient and their clinical situation and functional status. The referring doctor has access to this information but may have limited understanding of the significance of radiological findings, especially when it is an incidental finding that falls outside their specialty. We aim to assess differences in radiologist practice and referring practitioners' expectations regarding verbal notification of findings, to improve communication between teams and ultimately optimise patient safety.

Methods

A survey comprising 33 questions (Appendix 1) was created by the study authors comprising a short clinical stem and a summary of findings. Questions were designed in groups to have identical findings with slightly different clinical stems, or identical stems with slightly different findings. These questions were then randomly distributed through the survey. The survey also collected data regarding the participants demographics such as level of seniority and department.

Online surveys were distributed via staff internal email utilising the Typeform survey platform at a single tertiary centre in Victoria, Australia. All responses were anonymous, with survey enrolment only establishing the participant's clinical role and level of experience. Participants were then provided with the survey and asked to respond whether they would expect (for referring practitioners) or issue (for radiologists) verbal notification of the relevant findings.

Statistical Analyses

Results were analysed using IBM SPSS Version 26.0 for Windows (SPSS Inc., Chicago, Ill, USA). Response rates were examined as percentages with 95% confidence intervals (95CI). Pearson Chi-square and Fleiss' Kappa values were calculated to examine significant differences and overall level of agreement, respectively. P values <0.05 were regarded as significant.

Ethics Approval

This study was approved by St Vincent's Hospital Melbourne Human Research Ethics Committee (reference QA 035/16).

Results

Response rate and sample characteristics

A total of 97 survey responses were received (Table 1), 17 from radiologists (10 registrars and fellows, 7 consultants) and 80 from non-radiology medical staff (23 interns and residents, 15 registrars and fellows, 42 consultants). The centre at which the survey was conducted employs 20 consultant radiologists including visiting medical officers (7/20, 35% response rate) and 12 radiology registrars (10/12, 83% response rate). The study site does not employ radiology residents or unaccredited registrars.

Overall results (Figure 1) show close correlation between referring clinician's expectation of verbal notification in 61% (95CI 57-66%) of scenarios overall, and radiologists issuing verbal notification in 58% (95CI 52-64%). Fleiss' kappa for inter-rater reliability was 0.24, indicating fair agreement. Stratifying results by level of experience demonstrated a trend of more experienced referring practitioners having an increased preference towards verbal notification (Figure 2). Clinicians with >10 years' experience expected notification in 67% of cases (95CI 59-75%), consultants of 5-10 years' experience in 68% (95CI 53-84%), consultants of <5 years' experience in 63% (95CI 51-74%), and registrars and fellows expected notification in 59% of cases (95CI 43-76%). Referring residents had the lowest expectation of notification at 55% overall (95CI 45-64%).

Analysis of radiologists stratified by level of clinical experience is limited, given only 17 respondents were included in this study. Overall trends suggest a decreasing rate of verbal notification as radiologist clinical experience increased, although this data did not reach statistical significance.

Regarding specific clinical scenarios and their responses, results are quoted as "referrer notification expectation percentage / radiologist call percentage / overall notification percentage".

A finding of pulmonary emboli was consistently verbally notified (89% / 91% / 89%). This did not change when it was the suspected diagnosis (Questions 5 and 13: 90% / 85% / 89%) or an unexpected incidental finding (Question 27: 88% / 100% / 90%). Likewise, the verbal notification of intracranial haemorrhage was consistently given and expected (88% / 84% / 87%). This rate remained high in

bleeds of varying chronicity and across clinical settings, including at home (Questions 11 and 31: 84% / 79% / 83%) and after a fall in hospital (Question 19: 95% / 94% / 95%).

Both referrers and radiologists were more likely to expect verbal communication for a pathologic fracture (Question 15: 64% / 71% / 65%) compared with a simple fracture (Question 1: 53% / 29% / 49%).

Chest x-ray findings of uncomplicated pneumonia were seldom verbally notified (Question 12: 21% / 18% / 21%), while features suspicious for tuberculosis were frequently communicated (Question 4: 81% / 88% / 83%). Latent tuberculosis in a patient being considered for anti-TNF therapy had lower overall notification rates (Question 21: 39% / 41% / 39%) in comparison.

An incidental 4cm abdominal aortic aneurysm did not have significantly different notification rates, regardless of whether this finding was seen in a 57 year old (Question 7: 39% / 29% / 37%) or an 81 year old (Question 17: 31% / 12% / 28%).

Significant differences were seen regarding the incidental finding of a large thyroid nodule on MRI spine, with referring practitioners preferring notification more often than provided (Question 30: 34% / 0% / 28%, p=0.005). Similarly, a likely diagnosis of lymphoma was expected to be notified by clinicians more often than provided by radiologists (Question 8: 71% / 41% / 66%, p=0.017), although in patients suspected of having renal tract malignancy and obstructing transitional cell carcinoma was more likely to generate a radiologist phone call (Question 16: 65% / 59% / 64%). These rates of notification more closely correlated with the rates of notification for hydronephrosis in the setting of a ureteric stone (Question 25: 59% / 82% / 63%).

In patients undergoing surveillance for previous colorectal cancer there were no differences in verbal notification rates between recurrent tumour (Question 14: 49% / 41% / 47%) or a new primary tumour (Question 6: 51% / 47% / 51%). The incidental finding of a renal neoplasm had higher verbal reporting rates when detected on CT colonography (Question 2: 80% / 77% / 79%) in comparison. Response rates by question are seen in Figure 3.

Discussion

Communication in modern medicine is vital to patient care. Modern radiology information systems can provide reports by email or directly to electronic medical records, however these processes, while efficient, do not guarantee that the report will be read or acted upon in a timely manner. There is no doubt that the radiologist has a responsibility to patient care[17] and although they are expected to call with urgent findings, the definition of urgent is open to interpretation. Studies have also shown that many reports are never read[4,5,6,18,19] and so important but non-urgent findings that are not verbally notified may go unmanaged by the referring doctor.

Our study intended to assess the correlation between radiologists and referring doctors regarding when an imaging finding should be communicated verbally. We found a fair correlation between the overall expectations of referring doctors and the reporting radiologists regarding notification.

There are clearly several factors that radiologists consider when deciding if a verbal call is required. High rates of verbal communication were seen for conditions that were potentially rapidly life threatening such as intracranial haemorrhage and pulmonary embolism. Notifying for some of these conditions may have become so ingrained during radiology training that they persist for related but less urgent conditions, given we found no significant difference between call rates for acute subdural haemorrhage and subacute to chronic subdural haemorrhage. Abdominal free gas, similarly, was verbally notified by all radiologists regardless of whether the patient was acutely post-operative or had a virgin abdomen.

Rates of notification were independent of whether the finding was expected or incidental if the condition was potentially rapidly life threatening, as demonstrated by the high call rates for pulmonary embolism regardless of the clinical scenario. However, conditions which are important but not immediately life threatening were less likely to be called, which may relate to an expectation that the radiologist has time to generate a formal written report and the referring doctor has time to read the report. This was demonstrated by the relatively low notification rates for findings of suspected, recurrent, or new tumours. While we did find higher rates of notification for a question detailing an obstructing ureteric tumour, response rates more closely correlated to call rates for stone related hydronephrosis, rather than new tumour notification. This may be due to the more urgent possibility of sepsis or impaired renal function due to this hydronephrosis, rather than any clinical urgency inherent to the tumour diagnosis. Higher rates of verbal notification of tumours was seen when found incidentally during CT colonography rather than as part of oncology surveillance, potentially due to expectations that oncology patients have more regular follow up and hence are more likely to attend to receive investigation results.

The age of a patient did not appear to be a significant factor as demonstrated with the similar rates of notification for the incidental finding of an abdominal aortic aneurysm. This may be related to the limited clinical information provided to radiologists not allowing accurate assessment of the patient's comorbidities or ECOG status, and subsequently a reduced ability to judge the clinical relevance of findings for any individual patient.

A significant difference between radiologist and referrer preferences was seen regarding an incidental thyroid nodule found on MRI cervical spine, with no radiologists verbally notifying but a third of practitioners expecting notification (34% vs 0%, p=0.005). Incidental thyroid nodules are a common imaging finding seen in 1 in 6 patients undergoing CT and MR examinations of the neck,[20] with the majority being benign or indolent in nature and suitable for non-urgent investigation.[21,22] While radiologists are likely to be exposed to the high incidence and low malignant potential of these incidental thyroid lesions during their practice, our sample of referring clinicians from varied fields may have been unfamiliar with head and neck imaging findings and their significance. This information gap may have contributed to this difference in notification preferences, with some radiology departments abroad seeking to address this gap through the addition of a standardised

information box to reports including thyroid nodules, [22,23] similar to interpretation aides seen on some pathology reports.

Overall trends suggested more senior referring practitioners expected verbal notification more often, while more senior radiologists provided verbal notification less often.

The finding of senior radiologists verbally notifying less often is similar to earlier research which found reduced calls for follow-up imaging as radiologist experience increased,[24] attributed to a decrease in the tendency to 'overcall' uncertain findings. A similar mechanism may account for the trend of reduced rates of verbal notification in more senior radiologists observed in our data.

Of interest is the higher rate of preferred notification seen in more senior referring clinicians. Given the high rates of test results that are not reviewed,[4,5,6,19] it is not surprising that senior practitioners, often balancing practice across multiple clinical sites, may rely on verbal notification of results. Routine review of reports or notifications through a computerised system is challenging when a practitioner is working off-site, and earlier research has demonstrated poor rates of timely follow-up for electronic alerts overall.[8] As such, more senior consultants may prefer verbal reports, even in more uncertain clinical scenarios, to mitigate the difficulty of routinely reviewing written reports of varying significance.

Recommendations

While our results otherwise show fair correlation, we have demonstrated some discrepancies in the verbal notification of results. In an effort to address these discrepancies, the RANZCR published their Critical Test Result Notification Position Statement in 2019.[10] This statement recommends that "critical findings, adverse events and adverse outcomes" are conveyed in a "clinically appropriate timeframe",[10] and our findings suggest this definition may have different meanings to referring practitioners and reporting radiologists of varying seniority and in certain scenarios. For this reason, the RANZCR does not provide a list of notifiable conditions but rather provides a framework and suggests development of local practice guidelines.

Similar documents published overseas have led to significant discussion around what expectations are placed upon radiologists in communicating results.[5,11,12,13,14] The authors feel there are similar discussions surrounding the RANZCR position statement, and that radiologists and referring practitioners must continue to foster a constructive relationship regarding the communication of emergent imaging findings. While guidelines offer some framework, they are generally inflexible and do not adapt to the significance of findings for individual patients. Fostering a working relationship between referring practitioners and radiologists is vital to produce a practical solution with all parties sharing responsibility for effective communication.

To improve the recognition of significant findings requiring notification, we suggest the continued emphasis of these findings throughout doctor-in-training pathways. In addition, referring practitioners should take note of the often sparse 'clinical details' section of the radiology request form,[25] with adequate histories and clinical questions shown to improve diagnostic accuracy and frame the urgency of any imaging findings.[26] Ongoing assessment of radiologist and referring practitioner expectations,

for example through regular audit of verbal notification practices, will also improve the communication of urgent findings and reduce over-notification. Our survey and results could be used as a tool to lead local discussion and development of regional guidelines tailored to individual radiology department reporting practices, and further improve the working relationship between referring practitioners and the increasing utilised service of diagnostic radiology.

A limitation of our study is that we have not qualitatively assessed which factors influence verbal reports. From experience extrinsic factors do exert an influence, such as competing workload demands and difficulty contacting the referring doctor. The time involved in providing and receiving verbal reports competes against the ever-increasing workload. For this reason, electronic alert systems have been implemented to alert referrers when an important result is available and to provide a read receipt to the radiologist once the report has been read. These systems ideally will reduce the number of calls that need to be made and received and will hopefully reduce communication errors. However, many practitioners may still prefer verbal notification of urgent imaging findings due to advantages of notification speed, certainty of receipt, and the options of clarification and closed loop communication of results as required. An assessment of referring practitioner preferences towards electronic notification systems was not attempted in our limited survey but may provide further guidance in hospital implementation of effective notification systems and guidelines.

A further limitation of this study was our modest sample size, particular of radiologist respondents. While referring clinicians were enrolled from various departments, our radiologist study population was limited by the number of radiologists employed at the single tertiary centre hospital assessed. While our findings reflect the practices of this particular radiology department, a large multi-centre survey involving multiple radiology departments would be required to assess prevailing reporting practices. Another unmeasurable variable when collecting data in an observed survey is the Hawthorne effect. This states that the responders, aware that their responses would be analysed, may alter their responses and behaviour in the survey to represent ‘ideal world’ as opposed to the ‘real world’ of busy practice, and may have influenced our results.

Conclusion

Improving the practice of urgent result notification to be more in line with referring practitioners’ expectations is necessary for effective medical practice. Missed or delayed findings attract considerable morbidity, mortality, and medicolegal consequence. Methods of improving notification systems, as well as any shortcomings identified, are likely to attract considerable attention given the recent publication of the 2019 RANZCR Critical Test Result Notification Statement. While our results show that overall practitioner and radiologist expectations correlate well regarding which findings warrant urgent notification, some discrepancies exist.

To address these discrepancies, we suggest the continued emphasis on the clinical relevance of findings in doctor-in-training pathways, as well as the implementation and encouragement of effective feedback systems between referring practitioners and radiologists. The continued development of effective clinical relationships and implementation of relevant local guidelines is essential for minimising patient harm from the delayed notification of important results.

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Table 1 – Results and Survey Respondents

Experience	**Role**		Verbal Notification	Written Report Only	Total
Resident	Referring Practitioner (n=23)	Responses	415	344	759
		%	55% (95CI 45-64%)	45% (95CI 36-55%)	100%
Registrar / Fellow	Referring Practitioner (n=15)	Responses	293	202	495
		%	59% (95CI 43-76%)	41% (95CI 25-57%)	100%
	Radiologist (n=10)	Responses	196	134	330
		%	60% (95CI 50-70%)	40% (95CI 31-50%)	100%
Consultant <5 years	Referring Practitioner (n=10)	Responses	206	124	330
		%	63% (95CI 51-74%)	38% (95CI 26-49%)	100%
	Radiologist (n=1)	Responses	20	13	33
		%	61% (95CI N/A)	39% (95CI N/A)	100%
Consultant 5-10 years	Referring Practitioner (n=6)	Responses	135	63	198
		%	68% (95CI 53-84%)	32% (95CI 16-47%)	100%
	Radiologist (n=2)	Responses	37	29	66
		%	57% (95CI 37-76%)	44% (95CI 24-63%)	100%
Consultant >10 years	Referring Practitioner (n=26)	Responses	573	285	858
		%	67% (95CI 59-75%)	33% (95CI 25-41%)	100%
	Radiologist (n=4)	Responses	71	61	132
		%	54% (95CI 39-69%)	46% (95CI 31-61%)	100%
Total		Responses	1721	1018	2739

	Referring Practitioner (n=80)	%	61% (95CI 57-66%)	39% (95CI 34-43%)	100%
	Radiologist (n=17)	Responses	324	237	561
		%	58% (95CI 52-64%)	42% (95CI 36-48%)	100%

Figure 1: Total Rates of Verbal Notification

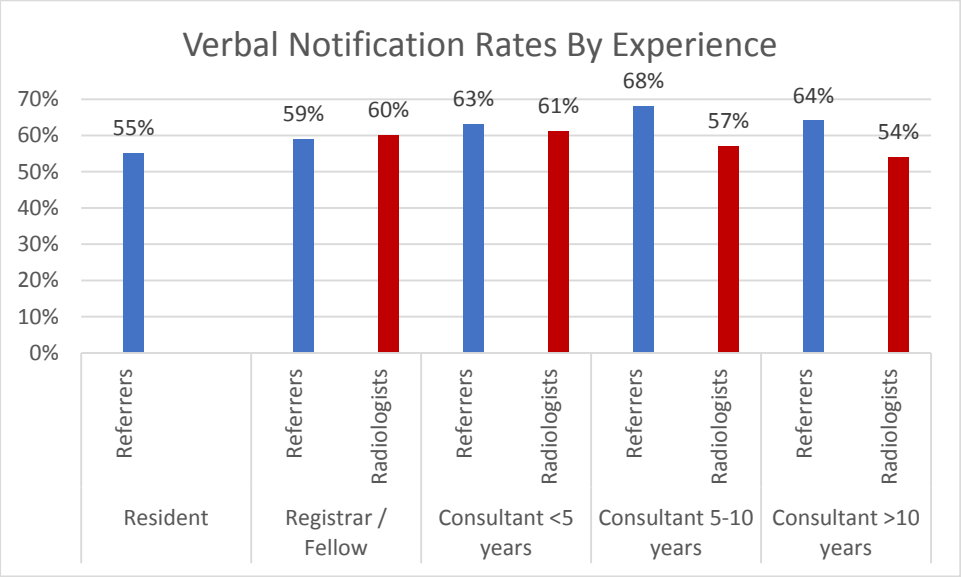

Figure 2: Verbal Notification Rates by Experience

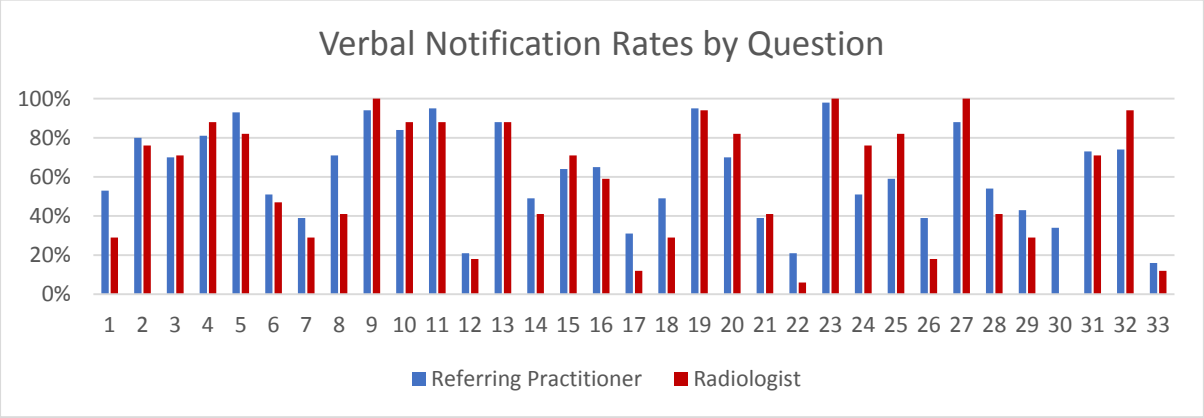

Figure 3: Verbal Notification Rates by Question