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ORIGINAL ARTICLE

Comparison between radiographers with sonography education working in remote Australia and radiologists' interpretation of ultrasound examinations

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Abstract

Introduction: Radiographers working in remote Far North Queensland (FNQ), Australia, need to possess unique skills sets in order to provide culturally safe practice to predominantly Indigenous communities. Due to the lack of onsite radiologists in FNQ, radiographers need to provide preliminary findings to referring practitioners including sonographic findings. The accuracy of such findings has not been evaluated to date. The objective of this study was to compare the level of agreement and recommendations for further investigations of FNQ radiographers to teleradiologists' reports. As radiographic findings are not recorded or stored as part of routine practice, only sonographic findings were included in the study. **Methods:** Consecutive de-identified ultrasound cases were extracted between January and March 2019 inclusively by an independent investigator. The researcher scored the ultrasound cases between 1 and 4 according to levels of agreement between sonographic findings and teleradiologists' reports, and recommendations between radiographers and teleradiologists were also compared using frequency analysis. **Results:** Five-hundred and thirty-two ultrasound cases were included for this study. Of those, 517 (97.2%) were in complete agreement and 15 (2.8%) reported minor discrepancies. There were no moderate or major discrepancies suggesting an overall accuracy rate of 100% as the radiographer/sonographer findings were in close agreement with the teleradiologists' reports. There was complete agreement regarding further clinical recommendations in 453 (85%) cases. The discrepancy in the remaining 15% of cases did not lead to any adverse or changed patient management. **Conclusions:** This study supports existing evidence about the accuracy and timely communication of sonographic findings to radiologists and other health care professionals, in keeping with the Medical Radiation Practice Board of Australia expectations. It is likely that radiographer comments on plain radiographic images are equally as reliable, but this remains to be explored.

Introduction

Radiographers employed in Far North Queensland (FNQ), Australia, work in complex environments that include geographical remoteness and the absence of support from onsite radiologists.[1] A 2014 position statement published by The Royal Australian and New Zealand College of Radiologists (RANZCR) acknowledges significant radiologist distribution shortages in rural and regional areas that has an impact on accessible radiology care and delayed reporting.[2] Radiologist expertise is provided solely via teleradiology in FNQ. However, teleradiology can result in delayed radiology reports that can be problematic in acute cases or emergency cases

where immediate patient management is required at the point of care.[3-4]

The population served in FNQ includes predominantly Aboriginal and or Torres Strait Islander peoples, respectfully named hereafter Indigenous Australians. There is a significant health gap between Indigenous Australians and non-Indigenous Australians with only 28% of Indigenous adults assessed to be in good health compared with 54% of non-Indigenous adults across Australia.[5] Elevated risk factors are associated with increased rates of hypertension, obesity and smoking.[5] Furthermore, pregnant Indigenous Australian women are at higher risk of both pregnancy and delivery-related complications.[6] Neonatal outcomes are also poorer compared to the non-Indigenous Australian population.[6] As ultrasound is the imaging modality of choice in pregnancy,[7] it is necessary that radiographers employed in FNQ acquire dual qualifications in both diagnostic radiography and medical sonography. These dual-qualified radiographers/sonographers are therefore registered with the Medical Radiation Practice Board of Australia (MRPBA) and accredited to practice medical sonography with the Australian Sonographer Accreditation Register (ASAR). They need to meet the expectations of both the MRPBA professional capabilities[8] and ASAR in regard to continuing professional development.[9] These new MRPBA professional capabilities include an expectation that registrants should be able to actively contribute to the immediate and appropriate management of patients needing urgent attention including the deteriorating patient,[8] communicate urgent or unexpected findings in a timely manner[10] and deliver culturally safe care.[8] Patient safety is inextricably linked to elements of clinical and cultural safety. Practising cultural safety requires MRPBA registrants to foster interprofessional collaborations and a safe and accessible working environment.[11]

Our previous observational study undertaken in FNQ demonstrated that the radiographers were able to optimise appropriate clinical management of acute cases by communicating radiographic and sonographic findings to the referring practitioners.[12] FNQ radiographers communicate radiographic findings verbally to the referring practitioner as radiographic findings are not uploaded on the Picture Archiving and Communication System (PACS). In contrast, it is common practice that these radiographers who also perform the ultrasound examinations, upload their written sonographic findings[9] into ViewPoint (ViewPoint (6) GE Healthcare, Solingen, Germany), the ultrasound database provided by the Department of Health (DoH) Queensland (QLD). ViewPoint (6) connects ultrasound devices and PACS to enable access to images, clips and volumes to facilitate radiologist remote reporting. The local referring healthcare professionals often collaborate with the radiographer/sonographer because they rely on the verbal reporting of sonographic findings directly from the radiographer/sonographer, given immediate radiologist reporting is commonly unavailable to support timely patient management.[12]

Numerous studies have reported on sonographer's accuracy when providing sonographic findings in Australia and internationally,[13–16] especially in relation to the accuracy of abdominal sonographic findings.[13–15] For example, a 2014 Australian study reporting on abdominal ultrasound referrals from emergency departments achieved complete agreement of 84.9% and a further 14.0% only had minor discrepancy between sonographers and radiologists.[14] Another 2021 Australian study comparing agreement levels between radiologists and sonographer's pelvic ultrasound findings concluded that sonographers could provide accurate interim reports when radiologists reports are delayed.[17] Overseas studies support these findings.[15,18–20] A European study reported that in the UK and Norway, radiographers provided full ultrasound definitive reports and also provided advice on further ultrasound investigations.[20]

To date, no research findings have been published comparing the levels of agreement of radiographers/sonographers working in remote areas without onsite radiologists to those of the reports made by teleradiologists in Australia. Building on our previous FNQ observational study,[12] this study sought to (1) evaluate the accuracy of FNQ radiographers/sonographers providing sonographic findings at two FNQ primary healthcare centres against the teleradiologists' reports; and (2) to compare the frequency of radiographers/sonographers and radiologists' recommendations for further investigations.

Methods

Ethical approval for the study was obtained from Human Resources Ethics Committee/ Torres and Cape Hospital and Health Service (TCHHS) (TCHHS/QIA/No. 20-10005) as well as from Monash University Human Resources Ethics Committee (MUHREC) (Project title: 27338) to extract de-identified data from two primary healthcare centres in FNQ. In addition, in principle support was obtained from the Executive Director of Allied Health, TCHHS. An independent investigator was appointed to compile a data base for the purpose of extracting consecutive de-identified sonographic cases from Viewpoint for the period January to March 2019 inclusive. Information collected for the study included agreement rates, recommendations for further

examinations, types of ultrasound examinations and clinical indications. The researcher scored the level of agreement by comparing the sonographic findings to those of the radiologists' reports by utilising four previously published diagnostic agreement scoring criteria[14, 17] as follows:

Category 1: complete agreement/matching with teleradiologists reports;
Category 2: minor discrepancy that would not impact patient management which included hedging terminology[21] and ambiguous differences, for example fatty versus moderate fatty liver;
Category 3: major discrepancy that would likely have an impact/change on patient management but would not lead to an adverse outcome for the patient; and
Category 4: major discrepancy that would impact patient management and lead to adverse outcomes for the patient.

As this is a retrospective study, teleradiologists were not blinded to the preliminary radiographer/sonographer findings. A frequency analysis determining the number of cases in each category was performed using SPSS (Statistical Package for Social Science, v.23; IBM, Sydney, Australia: https://www.ibm.com/au-en/analytics/spss-statistics-software. The analyses also compared the frequency of recommendations for further investigations and the different types of ultrasound examinations performed.

Results

The eight participants in this study were radiographer/sonographer practitioners, with sonography experience ranging from 3 to 8 years. In total, 710 de-identified radiographer/sonographer reports were retrieved. Of those, one hundred and seventy-eight [(N = 178/710 (25%)] were rejected. This was due to incorrect matching of reports (n = 3/178), incomplete uploaded radiographer/sonographer reports (n = 22/178) and 153/178 radiographer/sonographer reports not available due to upload errors. Five hundred and thirty-two [(n = 532/710 (75%)] radiographer/sonographer reports were included in the study. Of the 532 cases, 517 (97.2%) were categorised as having complete agreement (Category 1) and 15 (2.8%) reported minor discrepancies (Category 2). The 15 cases categorised as category 2 included two obstetric, three abdomen, three urinary tract, four pelvis and three musculoskeletal (MSK) cases. There were no cases reported as either category 3 or 4. (Table 1).

A variety of ultrasound examinations were undertaken with obstetric [(n = 135/532 (25.4%)] and general abdominal cases [(n = 116/532 (21.8%)] the most common. (Table 2). A wide range of MSK examinations were identified (Table 3) with the shoulder [(n = 34/101 (33.7%)] the most common MSK anatomical area performed. The majority of obstetric examinations were dating scans [(n = 52/135 (38.5%)], follow-up obstetric examinations [(n = 40/135 (29.6%)] and morphology scans [(n = 33/135 (24.4%)]. The majority of abdominal examinations included general indications [(n = 68/119 (57.1%)] and hernias [(n = 23/119 (19.3%)] (Table 4). Other abdominal indications included appendix [(n = 13/119 (11%)], follow-up [(n = 10/119 (8.4%)], infection [(n = 2/119 (1.7%)], congenital [(n = 2/119 (1.7%)] and intussusception [(n = 1/119 (0.8%)]. The majority of pelvic examinations were performed for pain [(n = 23/60 (38.3%)], bleeding [(n = 16/60 (26.7%)] and follow-up [(n = 10/60 (16.7%)] to monitor ovarian cyst sizes (eight cases), endometrial thickness (one case) and the size of an intramural fibroid (one case). Urinary tract examinations performed were for general [(n = 39/47 (82.9%)], prostate [(n = 6/47 (12.8%)] and follow-up [(n = 2/47 (4.3%)] indications. A variety of small parts examinations included the scrotum [(n = 9/19 (47.4%)], thyroid [(n = 8/19 (42%)], parotid [(n = 1/19 (5.3%)] and submandibular glands [(n = 1/19 (5.3%)]. Doppler

Table 1. Diagnostic agreement categories.

Diagnostic agreement: Ultrasound Examinations (N = 532)		
Category	Frequency	Percentage
Category 1	517	97.2
Category 2	15	2.8
Category 3	0	0
Category 4	0	0
Total	532	100.0

Table 2. Types of ultrasound examinations performed by radiographers/sonographers.

Ultrasound Examinations (N = 532)		
Examination	Frequency	Percent
Obstetrics	135	25.4
Abdomen	116	21.8
MSK	102	19.2
Urinary Tract	50	9.4
Doppler	23	4.3
Small Parts	19	3.6
Breast	14	2.6
Chest	7	1.3
Neck	6	1.1
Total	532	100.0

Table 3. Different types of musculoskeletal examinations performed (n = 101/532 (19%)).

MSK Examination	Frequency	Percent
Shoulder	34	6.4
Hand and Fingers	15	2.8
Hip	11	2.1
Knee	9	1.7
Elbow	7	1.3
Foot	7	1.3
Ankle	7	1.3
Leg	3	0.6
Forearm	3	0.6
Face	2	0.4
Buttock	1	0.2
Abdomen	1	0.2
Neck	1	0.2
Total	101	19.0

Table 4. Most common clinical indications.

Abdomen: N = 119/532			Obstetric: (N = 135/532)		
Indication	Frequency	Percent	Indication	Frequency	Percent
General	68	57.1	Dating Scan	52	38.5
Hernia	23	19.3	Follow-up	40	29.6
Appendix	13	10.9	Morphology	33	24.4
Follow-up	10	8.4	Other	10	7.4
Other	5	4.2			
Total	119	100	Total	135	100

studies of the leg [(n = 15/23 (65.2%)], carotid [(n = 6/23 (26.1%)], pelvis [n = 1/23 (4.35%)] and renal [(n = 1/23 (4.35%)] vessels were performed. Breast examinations [(n = 14/532 (2.6%)] were mainly performed for general indications such as a lump [(n = 11/14 (78.6%)], follow-up [(n = 2/14 (14.3%)] and infection [(n = 1/14 (7.1%)].

In 140 of the 532 cases (26.3%), recommendations were made for further diagnostic tests. In 61 of those cases (43.6%), the radiographers/sonographers and teleradiologists agreed on their recommendations. Teleradiologists made a further 70 recommendations (50%) not made by the radiographers/sonographers. They suggested clinical or other laboratory tests in 37/70 (53%) cases and follow-up ultrasound examinations in 28/70 (40%) cases. In 5/70 (7%) cases, radiologists suggested alternative imaging after clinical correlation, with recommendations for MRI in three cases, plain abdomen X-ray in one case and CT IVP in the other case.

In the case of all 70 recommendations made by the teleradiologists but not by the radiographers/sonographers, hedging terminology was used that did not influence the immediate patient management. Two of those cases were from category 2 with minor discrepancies. One of those cases confirmed that Morton's Neuroma was not identified, but suggested intermetatarsal bursitis with further clinical correlation recommended by the teleradiologist. The other was an obstetric case where sonographic findings showed a short femur, but foetal growth was appropriate. The radiologist suggested a follow-up scan in 4–6 weeks to review this case.

Of the 140 cases with recommendations, radiographers/sonographers made nine recommendations (6.4%) that were not included in the radiologist report. Of the nine cases where radiographers/sonographers made further recommendations, three included recommendations for follow-up morphology scans that the radiologists did not suggest. The radiographers/sonographers made additional recommendations in the following four cases: (1) scanning at a different stage of the menstrual cycle to better assess the endometrium, (2) non-invasive prenatal testing due to advanced maternal age, (3) correlation with biochemistry to diagnose polycystic ovarian syndrome and (4) clinical correlation for polycystic ovarian syndrome. The radiographers/sonographers reported technical difficulties in two cases due to patient habitus and recommended alternative imaging. However, the radiographers/sonographers' recommendations did not have an impact on the immediate management of patients.

Discussion

Our findings have demonstrated that FNQ radiographers/sonographers have high levels of agreement with teleradiologists' reports. All of the 532 ultrasound cases were categorised as either category 1 or 2, suggesting an overall accuracy rate of 100% as the radiographer/sonographer findings were in close agreement with the teleradiologists reports. As radiologists report remotely in FNQ, their reports are generated from preliminary radiographer/sonographer findings. The levels of agreement suggest that there is a high level of trust between the radiographers/sonographers in this setting.[22] All of those cases had minor discrepancies mainly due to descriptive differences in the teleradiologist versus the radiographer/sonographer findings but with similar pathology agreement. Those minor discrepancies did not alter immediate patient management.

The findings of this study confirm previous studies that radiographers/sonographers have high levels of agreement with radiologists reports.[13–20, 23–25] In the 70 cases where only the radiologists made further recommendations, radiologists recommendations included hedging

terminology such as 'it is suggested that', 'I recommend that' 'it may be considered'. The additional recommendations did not include clear instructions for amendments in patient management. In Australia, sonographic findings are mainly intended as a communication tool for radiologists. Although the teleradiologists did not suggest alternative imaging in the nine cases where radiographers/sonographers made further recommendations, their reports acknowledged that some structures were poorly visualised due to patient habitus in those cases. The discrepancies in recommendations did not have an impact on the immediate management of patients.

This study has demonstrated that FNQ radiographers/sonographers need to be proficient in a wide variety of ultrasound examinations in order to actively contribute to the immediate management of Australians living in remote communities. In addition, undertaking paediatric ultrasound examinations to confirm/exclude clinical indications such as appendicitis, congenital conditions and intussusception adds to the skill base radiographers/sonographers working in settings such as FNQ need to possess. The majority of ultrasound cases were obstetric scans, which had also been the case in our previous FNQ observational study.[12] As previously reported, this situation highlights the importance of high-level communication skills and the ability to be culturally sensitive by ensuring that significant findings are conveyed accurately and that interprofessional collaborations are robust in order to contribute to clinical decision-making of acute cases and patient management in remote settings.[12]

It is recommended that the professional bodies as well as the diagnostic imaging employers encourage the continued development of multimodality expertise by radiographers. The development of multimodality expertise not only provides an improved service to under-resourced communities but also has the potential to lead to an improved professional status for radiographers in Australia. The MRPBA acknowledges that more experienced practitioners may assume different responsibilities and that they may be expected to provide direction to other members of the healthcare team when appropriate.[8–13] Definitive reporting for radiographers and sonographers in Australia has not yet been realised. This is in contrast to the UK where radiographer and sonographer reporting has been practised for many years.[26]

Limitations

None of the FNQ radiographers/sonographers involved in this study received formal training in definitive ultrasound reporting. As this is a retrospective study, radiologists were not blinded to the radiographer/sonographer findings that introduces a level of bias as a high level of agreement should be expected. This study investigated only two FNQ primary healthcare centres in remote Queensland where radiographers/sonographers work without onsite radiologist support. Hence results from this study should not be generalised to metropolitan regions.

Conclusion

It is recommended that professional associations representing radiographers, sonographers and radiologists in Australia, namely the Australian Society of Medical Imaging and Radiation Therapy, the Australasian Sonographers Association and RANZCR, collaborate to include clinical reporting for suitably trained radiographers and sonographers, which can have the potential to improve health outcomes for all Australians living in remote areas, but in particular Aboriginal and Torres Strait Islander peoples. Sonographic findings are designed to assist radiologists in their reporting. Agreement levels between radiographers/sonographers and radiologists were very high and support existing evidence about the accuracy and timely communication of sonographic findings to radiologists and other healthcare professionals, in keeping with MRPBA expectations. This study provides a glimpse into a model of radiography that the MRPBA purports to support as it shows that radiographers can act as professionals with full autonomy to direct patient management in the absence of radiologists.

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Conflict of interest

The authors declare no conflict of interest.

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