The Royal New Zealand College of General Practitioners
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CORRIGENDUM

Guidelines, training and quality assurance: influence on general practitioner MRI referral quality

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The author qualifications of Dr Tara Officer, co-author of this article published in the June issue of *Journal of Primary Health Care* were incorrect. Dr Officer's correct qualifications are: BPharm, DPH, PhD, RegPharmNZ.

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ORIGINAL RESEARCH PAPER

ORIGINAL RESEARCH: HEALTH SERVICES

Guidelines, training and quality assurance: influence on general practitioner MRI referral quality

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ABSTRACT

INTRODUCTION: Magnetic resonance imaging (MRI) is an accurate diagnostic test used mainly in secondary care. Uncertainty exists regarding the ability of general practitioners (GPs) to use direct access high-tech imaging pathways appropriately when managing musculoskeletal injury.

AIM: To evaluate the use of primary care-centric guidelines, training and quality assurance on the appropriateness of GP MRI referrals for patients with selected musculoskeletal injuries.

METHODS: This is an 18-month primary care retrospective study. GPs participated in clinical musculoskeletal training, enabling patient referral for MRI on four body sites. Two reviewers categorised referral appropriateness independently, and reviewer inter-rater agreement between categorisations was measured. MRI results and patient management pathways were described. Associations of scan status and patient management were examined using logistic regression.

RESULTS: In total, 273 GPs from 72 practices attended training sessions to receive MRI referral accreditation. Of these, 150 (55%) GPs requested 550 MRI scans, with 527 (96%) eligible for analysis, resulting in 86% considered appropriate; 79% consistent with guidelines and 7% clinically useful but for conditions outside of guidelines. Inter-rater agreement was 75%. Cohen's weighted kappa statistic was 0.38 (95% CI: 0.28–0.48). MRI referrals consistent with guidelines were more likely to show pathology requiring specialist intervention (reviewer 1: odds ratio = 2.64, 95% CI 1.51–4.62; reviewer 2: odds ratio = 4.44, 95% CI 2.47–7.99), compared to scan requests graded not consistent.

DISCUSSION: Study findings indicate GPs use decision support guidance well, and this has resulted in appropriate MRI referrals and higher specialist intervention rates for selected conditions.

KEYWORDS: General practitioner; magnetic resonance imaging; direct access; guidelines; training; quality assurance

WHAT GAP THIS FILLS

What is already known: Magnetic resonance imaging (MRI) is commonly used in secondary care to assist in the diagnosis and management of musculoskeletal conditions. The benefit of GP direct access to MRI has received considerable attention internationally, with limited agreement.

What this study adds: This study from New Zealand reports on the use of guidelines, training and quality assurance reporting as interventions to facilitate effective direct access MRI for GPs. When GP referrals followed guidelines, there were fewer inappropriate referrals and higher rates of intervention by secondary specialist services, demonstrating appropriate use of MRI in primary care is achievable with a decision support framework.

Introduction

Musculoskeletal disorders comprise at least 25% of New Zealand's annual health spending,[1] paralleling international data,[2–5] and resulting in significant morbidity and social costs[1,6,7] for approximately one-in-four New Zealand adults.[1] Musculoskeletal disorder management often occurs in primary care, but in some cases, patients require additional high-tech imaging that is accessible only by secondary care referral, creating barriers to definitive care. To evaluate service delivery effect, invited general practitioners (GPs) working in one region participated in a study altering usual treatment pathways, allowing trained GPs to refer patients directly to publicly funded magnetic resonance imaging (MRI).

Limited evidence exists of the diagnostic effectiveness of direct GP MRI referrals. Several studies indicate MRI requests from GPs and other non-orthopaedic specialists lack diagnostic relevance.[8–10] Lehnert and Bree[9] suggest that unsuitable MRI and computed tomography (CT) referrals occur because of medical liability fear, economic motivation, regional differences, patient demand and inadequate doctor training or experience. They found that individuals with inappropriate imaging referrals were 3.5-fold more likely to have negative results than patients with appropriate referrals.[9] Much of the available evidence surrounding direct MRI referral pathways recommends use of guidelines, training or both to facilitate correct referral practices.[10–12]

MRI is an established secondary care tool for diagnosing selected musculoskeletal conditions. Over the past 20 years, as part of a drive to manage patient journeys more efficiently and to improve use of health system resources, several countries have trialled direct access MRI referrals.[8,10,13,14] This paper reports on the New Zealand experience of direct access MRI, specifically focusing on whether pre-training and quality assurance frameworks can lead to appropriate GP access to deliver suitable patient management outcomes. Given uncertainty around introducing earlier GP access to funded MRI, the primary aim of this study was to examine whether a decision support framework of guidelines, training and quality assurance resulted in clinically appropriate use of MRI. Further, this study assessed post-scan patient management as a consequence of MRI use in primary care.

Methods

Design and setting

An observational study was conducted in ProCare, a primary health organisation,[15] with 825,052 enrolled patients.[16] GP participation initially began as a 38-practice pilot study and gradually expanded to 72 practices, almost 25% of all primary care clinics in urban Auckland.

Recruitment and training

Guidelines were based on a modified collective version of Accident Compensation Corporation (ACC), New Zealand and Department of Health, New South Wales, Australia diagnostic imaging and musculoskeletal management guidelines.[17,18] These were adjusted to be general practice-centric, supported with expert and sector review. Guidelines focused on four body sites: knee, shoulder, cervical and lumbar spine.

GPs were invited to participate in a musculoskeletal training and MRI referral accreditation programme. GP inclusion began after attending two separate 2-h musculoskeletal assessment education sessions accredited by ProCare's Clinical Quality and Education Committee. Education consisted of sessions delivered by a clinical lead (S. Kara) and small group 'hands-on' primary care-centric clinical examinations focusing on the relevant clinical

indications (Table 1). A ratio of one educator to six GPs ensured group participation. Educators were experienced sports medicine practitioners and musculoskeletal physiotherapists.

On average, 25 GPs attended each clinical education session. GPs were continually entering the training programme in tranches throughout this study. Ninety-six percent of practices supported sending their GPs for annual re-training. Re-training consisted of initial training material further contextualized from learnings through the study period. Ongoing annual accreditation is currently expected, but may alter in content delivery.

Referral process

Following education sessions, GPs referred consenting patients for MRI, or followed usual care practice. A single radiology provider conducted all MRIs. Radiologist reports detailing MRI findings and clinical recommendations based on these findings were electronically sent to referrers. Radiologists were available to discuss reports and to upskill GPs on body site-specific findings.

Data collection and analysis

GP MRI referral data and subsequent patient management outcomes were collected. The clinical lead reviewed all data for quality assurance purposes. Data were received from ProCare and radiology provider databases. Cases were individually analysed, with imaging results and clinical referral diagnoses matched against guidelines compliance. Individual case data included age, sex, GP clinical notes, clinical indications for referral and MRI findings. Data were graded as shown in Table 2. Referrals not reviewed (grading system V) included instances where patients did not attend appointments or were non-contactable ($n = 5$), had scans completed elsewhere ($n = 8$), were declined ACC cover ($n = 1$), had imaging contraindications ($n = 4$) or missing scan reports ($n = 5$). MRI requests that were inconsistent with guidelines (III and IV) were discussed with the referring GP, facilitating GP accountability and closing quality assurance feedback loops. Patient management post-MRI was assessed by reviewing clinical notes (Table 3) to evaluate the direct access pathway effect on subsequent treatment.

Table 1. Clinical indications for magnetic resonance imaging (MRI) referral in patients aged over 15 years

Body site	Indication
Knee	Major ligamentous disruption (Anterior Cruciate Ligament, Posterior Cruciate Ligament, Lateral Collateral Ligament) Meniscal pathology with mechanical symptoms for patients with or without knee osteoarthritis (OA) or pain in those patients without knee osteoarthritis
Lumbar spine	Radicular pain >6 weeks' duration with relevant clinical signs Radiculopathy >6 weeks' duration with relevant clinical signs
Cervical spine	Radicular pain >6 weeks' duration with relevant clinical signs Radiculopathy >6 weeks' duration with relevant clinical signs
Shoulder	Glenohumeral joint instability (dislocation or subluxation) Persistent kinematic shoulder pain of more than 6 months' duration with appropriate prior rehabilitation

Table 2. Magnetic resonance imaging referral grading system

I.	Referral consistent with guidelines
II.	Referral recommended by specialist (following phone consultation if GP unsure MRI indicated)
III.	Referral not consistent with guidelines, but clinically indicated
IV.	Referral neither consistent with guidelines nor clinically indicated
V.	Referral not reviewed

Table 3. Clinical outcome grading post-magnetic resonance imaging

A.	Specialist referral: surgical management
B.	Specialist referral: non-surgical interventional management (e.g. injection therapy)
C.	Specialist referral: non-surgical active rehabilitation
D.	No specialist referral: active rehabilitation via usual care (mainly physiotherapist)

Following collection of 550 MRIs, a second reviewer from a different region independently assessed all data for referral alignment with guidelines. This clinician and the clinical lead each had 20 years' experience in primary care and musculoskeletal and sports medicine. Reviewers had access to all clinical information and radiology reports, but were blinded to each other's assessment findings.

Statistical analysis

Consistency of reviewer interpretation was evaluated by calculating overall reviewer agreement in

Table 4. Alignment of magnetic resonance imaging requests with guidelines, overall and by body site

			Guideline alignment (*n* (%))				
	n (%)	Reviewer	I	II	III	IV	V
Cervical spine	33 (6)	1	27 (82)	1 (3)	1 (3)	3 (9)	1 (3)
		2	26 (79)	1 (3)	3 (9)	2 (6)	1 (3)
Knee	309 (56)	1	224 (72)	13 (4)	14 (5)	45 (15)	13 (4)
		2	210 (68)	13 (4)	32 (11)	41 (13)	13 (4)
Lumbar spine	174 (32)	1	127 (73)	9 (5)	7 (4)	23 (13)	8 (5)
		2	139 (80)	9 (5)	12 (7)	6 (3)	8 (5)
Shoulder	34 (6)	1	16 (47)	5 (15)	5 (15)	7 (20)	1 (3)
		2	7 (20)	5 (15)	2 (6)	19 (56)	1 (3)
Total	550 (100)	1	394 (72)	28 (5)	27 (5)	78 (14)	23 (4)
		2	382 (70)	28 (5)	49 (9)	12 (12)	23 (4)

referrals for three groups: grades I–II, grade III and grade IV. Cohen's weighted kappa statistic[19] was calculated, using quadratic weights to allow a disagreement of grade I–II vs. grade III to be given partial credit (weight = 0.75) compared to the more discordant combination of grade I–II vs grade IV (weight = 0). Referrals not reviewed (grade V) were excluded from the agreement analysis. Differences in type of referral according to body site were assessed using Fisher's exact test. The odds of patient management outcomes according to scan status were derived using logistic regression. Analyses were conducted in Stata, version 15 (StataCorp, College Station, TX, USA).

Approval for an evaluation of the high-tech imaging pathway was obtained from the ACC Ethics Committee on 8 March 2017 (no approval number).

Results

Overall, 273 GPs from 72 practices attended training sessions and received MRI referral accreditation. Over an 18-month period (Feb 2017–July 2018), 150 GPs requested 550 MRIs of four body sites (Table 1), averaging 30 MRIs per month from all eligible GPs. These GPs comprised 55% of accredited GPs, and they requested between one and 16 MRIs (mean 3.7), with 88% percent of MRI requests for knee or lumbar spine pathology (Table 4). A total of 23 requests fitted under grade V and were not analysed. Monitoring did not indicate that later-trained GPs delivered different quality clinical outcomes than earlier-trained GPs.

Referral quality

Between reviewers, on average, 79% of reviewed scans (Table 4) were considered consistent with guidelines or as recommended by musculoskeletal medicine specialists (grade I and II). A further 7% of MRI requests were clinically indicated, but fell outside guidelines (grade III) and 14% percent of reviewed MRI requests were considered unnecessary. Overall agreement between reviewers was 75%. Cohen's weighted kappa statistic was 0.38 (95% CI: 0.28–0.48, $P < 0.001$), indicating weak-to-moderate inter-rater agreement; with a proportion of consistent ratings of 0.7, there was 90% power to detect kappa ≥0.4.[20] Kappa measures the amount of agreement beyond that expected by chance, so one reason kappa appears low is due to the proportion of expected agreement and overall prevalence of consistent ratings both being high.[20]

For reviewers, MRI request alignment with guidelines differed by body site (reviewer 1, $P = 0.04$; reviewer 2, $P < 0.001$). There was less agreement between reviewers for shoulder imaging requests (Table 2), reflecting the diagnostic complexity shoulders pose.[21,22] Most grade IV shoulder scans were inside the required time for guideline compliance (<6 months). Irrespective of shoulder referral grading, 75% resulted in specialist intervention.

Patient management outcomes

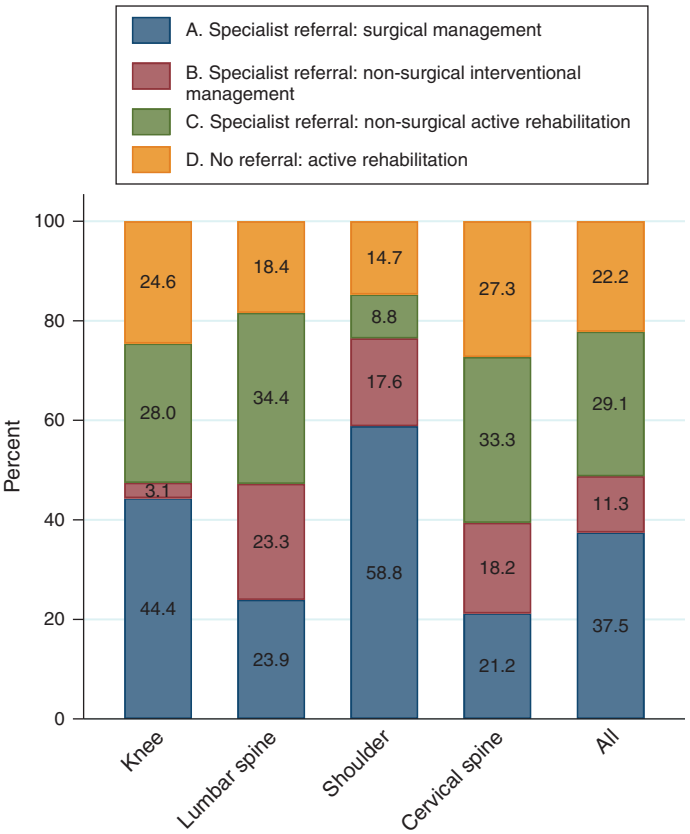
Analysis of patient management outcomes post-MRI (Fig. 1) showed 78% of all MRI requests resulted in specialist referral; 49% benefiting from specialist intervention by surgical management (outcome A) or non-surgical intervention (outcome B), with 29% advised rehabilitation (outcome C). The remaining patients did not receive specialist review; their GPs instead prescribed active rehabilitation. Data for 27 (5%) patient management outcomes could not be found.

Further sub-group analysis by body site (Fig. 1) showed 76% of shoulder referrals resulted in specialist intervention. Lumbar spine and knee referrals resulted in lower but similar rates of specialist intervention (outcomes A or B).

Patients with scans that were consistent with guidelines, specialist recommended or otherwise clinically indicated (grades I–III) were more likely to receive subsequent specialist interventional management, according to reviewers ($P < 0.001$; Table 5). MRI requests consistent with guidelines or recommended by specialists were between 2.64- (95% CI 1.51–4.62) and 4.44- (95% CI 2.47–7.99) fold more likely to lead to specialist intervention (outcomes A or B) than grade IV scans. MRI referrals that were inconsistent with guidelines but clinically indicated (grade III) were also more likely to lead to specialist services, although this effect reached statistical significance for only one reviewer.

Conversely, the odds of patients not receiving specialist referral, but instead being managed by active rehabilitation alone (outcome D) were significantly higher (between 2.70 (95% CI 1.56–4.65) and 3.39 (95% CI 2.02–5.69)) where GP MRI referrals were not clinically indicated and inconsistent with referral guidelines ($P < 0.05$ for all associations according to both reviewers; Table 5).

Figure 1. Patient management outcomes post-magnetic resonance imaging (MRI; n = *523) by body site.*



Discussion

During the study period, 55% of trained eligible GPs requested MRI scans. On average, 79% of MRI requests were consistent with guidelines, increasing to 86% if all clinically indicated scans were included. Compliance with imaging guidelines increased the likelihood of specialist intervention for patients by at least 2.5-fold, compared to patients who did not meet the clinical criteria for MRI scanning. Although inter-rater reliability was weak to moderate, outcomes supported use of the guidelines independent of reviewers.

Strengths and limitations

This New Zealand study reports on the effect on patient care of expanding MRI access to GPs. The patient population is representative of the Auckland region of 1.66 million, with eligible GPs' enrolled patients making up 36% of the region's total population. Study data were gathered over 18 months, giving GPs time to learn from the training provided and enabling implementation monitoring. Use of real-world practice settings with accurate measurement of post-MRI outcomes is a strength in identifying potential benefits.

Table 5. Odds of patient outcomes according to guideline alignment (n = 508)

Outcome	Guideline alignment comparison		Reviewer	Odds ratio (95% CI)	*P*
Specialist interventional management (A or B)	I: Consistent	vs. IV: Neither consistent nor clinically indicated	1	4.41 (2.45–7.95)	<0.001
			2	2.60 (1.49–4.57)	0.001
	II: Specialist recommended		1	4.92 (1.94–12.46)	0.001
			2	3.13 (1.26–7.81)	0.01
	III: Not consistent, but clinically indicated		1	2.90 (1.11–7.60)	0.03
			2	1.96 (0.89–4.32)	0.10
	I–II combined		1	4.44 (2.47–7.99)	<0.001
			2	2.64 (1.51–4.62)	0.001
	I–III combined		1	4.34 (2.42–7.77)	<0.001
			2	2.56 (1.47–4.47)	0.001
No specialist referral Management via rehabilitation (D)	IV: Neither consistent nor clinically indicated vs.	I: Consistent	1	3.18 (1.88–5.38)	<0.001
			2	2.62 (1.51–4.56)	0.001
		II: Specialist recommended	1	6.20 (1.72–22.35)	0.005
			2	5.28 (1.45–19.28)	0.01
		III: Not consistent, but clinically indicated	1	5.46 (1.50–19.83)	0.01
			2	2.47 (1.02–5.96)	0.05
		I–III combined	1	3.39 (2.02–5.69)	<0.001
			2	2.70 (1.56–4.65)	<0.001

CI (confidence interval).

Limiting factors include the lack of a control group and the unknown size of the eligible pathway patient cohort (denominator). Patients may not have been referred for MRI post clinical assessment because of appropriate use of the pathway; collecting data on this was not feasible. Consequently, the study group may not be representative of all MRI eligible patients. However, the study's aim was to assess appropriate use of MRI, rather than uptake against population baselines.

GP participants had varied backgrounds, educations and ages. Only 55% of accredited GPs requested MRIs, possibly indicating differences in decision-making between GPs who did and did not request MRIs. This could reflect improvements in GP confidence post-training programme participation, desire to use these pathways, or differences in practice demographics.

Generalisability of this service delivery model to other New Zealand areas has not been tested, and we did not monitor GP MRI referral decisions, either by human or artificial intelligence. Evaluating how GP decision-making changes over time could establish whether the effectiveness of GP MRI referrals could be attributed to the Hawthorne Effect.[23] Direct access MRI cost-effectiveness was not considered.

Comparison with existing literature

There is limited agreement in existing literature on the benefit of GP direct access MRI pathways. The DAMASK (Direct Access to Magnetic Resonance Imaging: Assessment for Suspect Knees) trial assessed the effectiveness of GP referral to early MRI and a provisional orthopaedic appointment, compared with referral to an orthopaedic specialist without prior MRI for patients with continuing knee problems over a 2-year period, for 553 patients recruited from 163 general practices.[14] The authors suggest increased GP diagnostic and therapeutic confidence because of imaging access. However, they state access to MRI did not influence GP decisions for specialist referral post-imaging, based

on the fact that only 10% of patients having pre-booked specialist appointments were cancelled by their GPs; this was used as a surrogate marker to support no change in GP referral patterns. However, this did result in an effective use of public resources through providing a small, but significant, improvement in patient quality-of-life measures. In a retrospective chart review, Roberts et al.[24] found specialist-generated MRI resulted in more appropriate interventions for symptomatic patients and more surgically amenable pathology compared to GPs. Debaters against GP direct access MRI pathways often identify situations where GPs lack dedicated pre-use training and quality assurance, and operate within an unlimited condition open access environment, factors which are critical to success.[10,24] These studies contrast with findings from The Netherlands, indicating changes in GP referral patterns following MRI referrals.[25] Roberts et al.[24] admit to the value of an educational primer as testament to effectiveness of careful clinical evaluation and prudent MRI use. Other studies support educational interventions and patient pre-selection as means of preventing increases in GP referral rates.[9,12,26]

Debate exists regarding unaltered patient outcomes following GP MRI use. A large Netherlands-based multi-centre, non-inferiority randomized control trial (TACKLE Trial = TraumAtic Complaints of the Knee — Leiden University Medical Center (LUMC) and Erasmus MC Trial) provides new evidence that GP MRI referrals (356 patients aged 18–45 years) for traumatic knee complaints following clinical pathways resulted in neither worse nor better outcomes than usual care for quality-of-life knee-related daily function during a 1-year follow up.[27] Our study shows decisions for specialist referral and appropriate intervention are improved when guidelines were consistently followed. The TACKLE Trial could be seen as a difference in management of operative versus non-operative care, rather than the role of MRI in outcomes. Their inclusion criteria of generalised knee complaint due to trauma or sudden onset adds weight to the use of specific condition clinical guidelines, such as those used in our study. Kisser et al.[12] and the TACKLE Trial team[27] both emphasise the importance of radiologist involvement in decision-making; something that our trial encouraged and was well-received by GPs.

Implications for research and practice

Study results show that when GPs participate in training and re-training programmes following established evidence-based guidelines, quality utilisation of diagnostic imaging can be achieved. International direction and New Zealand health policy emphasise the value of delivering services in primary care, reducing secondary care reliance and enabling GPs to work at 'top of scope'. This study demonstrates an opportunity to improve use of primary care services and expand GP capabilities. Findings show that where GPs refer patients for MRI in alignment with clinical guidelines, more appropriate use of specialist services occur. GPs can be confident that should conditions fall outside guidelines, patient rehabilitation is likely without MRI. Education and guidelines use inside a quality assurance framework present an opportunity to deliver continued evidence-based practice. Testing this on a larger scale may be the next step.

Only 55% of eligible GPs referred patients for MRIs. Reasons for the remainder not using this referral pathway were not explored, but are the subject of future research. Anecdotal feedback suggests clinical guidelines were followed, with MRI not required for diagnosis.

These results suggest clinical training, quality assurance procedures and subsequent consistent GP guideline use led to appropriate direct specialist referral. Without discouraging specialist opinion for clinicians when diagnostic uncertainty exists, use of timely imaging for selected conditions before secondary care review can be supported with guideline use and monitoring.

Competing interests

The authors declare no competing interests.

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