



Requesting spinal MRIs effectively from primary care referrals

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Abstract

Objective To define if MRI scans can accurately be requested based on information provided in the primary care referral and, therefore, streamline the patient journey.

Summary of background data The demand for outpatient spinal appointments significantly exceeds our services' ability to provide efficient, high-quality patient care. Currently, magnetic resonance imaging (MRI) of the spine is requested following first consultation.

Methods During routine vetting of primary care referral letters, three consultant spinal surgeons recorded how likely they thought each patient would be to have an MRI scan. Following the first consultation with the spinal service, the notes of each patient were reviewed to see if an MRI was requested. We measured the positive predictive value (PPV), negative predictive value (NPV), sensitivity and specificity of ordering MRI scans based on primary care referral letters.

Results 149 patients were included [101 females, 48 males, mean age 49 (16–87)]. There were 125 routine, 21 urgent, and 3 'urgent-suspected cancer' referrals. The PPV of ordering MRIs before first consultation was 84%, NPV was 56% with the sensitivity and specificity being 82 and 59%, respectively. Ordering MRIs during initial vetting could shorten the patient journey with potential socioeconomic benefits.

Conclusions MRI scans can be effectively ordered based on the information provided by the primary care referral letter. Requesting MRI scans early in the patient journey can save considerable time, improve care, and deliver cost savings.

Graphical abstract These slides can be retrieved under Electronic Supplementary Material.

Key points

[List your key words here]

1. Outpatient department
2. Magnetic resonance imaging
3. Quality Improvement
4. Patient Care
5. General Practitioners
6. Quality of Patient Care
7. Sensitivity
8. Specificity
9. Streamline Patient Journey

[Citation]

Table 3: Specificity, sensitivity, PPV and NPV of ordering MRI at vetting referrals

Statistics	Value	Confidence Intervals
Sensitivity	82.4%	74.2% to 88.4%
Specificity	58.5%	43.4% to 72.2%
Positive Predictive Value	84.0%	75.8% to 89.7%
Negative Predictive Value	55.8%	41.1% to 69.6%
Likelihood Ratio	1.99	

[Citation]

Take Home Messages

[List your Take Home Messages here]

1. MRI scans can be effectively requested at initial vetting using primary care referrals with an 84% positive predictive value.
2. Requesting MRI scans early in the patient journey can have huge benefits in waiting times, stratify urgent referrals for early intervention.
3. Service redesign will aim at accurately triaging patients with no additional cost, with the promise of cost savings and socioeconomic benefits.

[Citation]

Keywords Outpatient department · Magnetic resonance imaging · Quality improvement · Patient care · General practitioners · Quality of patient care · Sensitivity · Specificity · Streamline patient journey

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Introduction

The demand for clinic appointments significantly exceeds the capacity within the spinal service, which includes urgent referrals with suspected cancer. In Scotland, there is a significant increase of 140,000 extra patients seen in the outpatient setting compared to 2009 [1]. This is reflected worldwide,

particularly in spinal services as various organisations utilise resources such as the multidisciplinary team, guidelines and pathways to streamline the patient journey [2–9].

Within NHS Greater Glasgow and Clyde, access to magnetic resonance imaging (MRI) of the spine by primary care is limited as patients are referred on to tertiary settings through the Scottish Care Information (SCI) gateway. MRIs are requested after first consultation with extended scope physiotherapist (ESP), surgeons or referring consultants (orthopaedics or other specialties). The current National Institute for Health and Clinical Excellence (NICE) guidelines on back pain and sciatica suggest that routine imaging is not offered in a non-specialist setting for patients with low back pain with or without sciatica [10]. To the best of our knowledge, no study to date has investigated if MRI scans can be accurately requested based on information provided from the primary care referrals prior to first consultation in the tertiary setting.

We present a prospective study examining the accuracy of MRI requests based on the information contained within general practitioner's referral letters, in an attempt to reduce the overall patient journey, arriving at a patient-centred management plan while achieving potential socioeconomic benefits.

Materials and methods

A prospective study was performed on all referrals to the spinal service for a period of 12 weeks, from 24th October 2015 to 15th January 2016. At vetting, three spinal consultants were required to record remarks based on the primary care referral; (1) whether MRI is likely or unlikely after first consultation. (2) If the patient should be seen at the new spinal clinic by a consultant/ESP/either. Patients were prospectively followed up from our electronic patient record (TrakCare® 2014 1.0 and Orion Health™ Clinical Portal Version 8.3).

Patient flow through the West of Scotland spinal service is shown in Fig. 1. All referrals ($n = 575$) over the 12-week study period were reviewed, in which we included (1) primary care referrals, (2) complete vetting outcomes and (3) patients being given a new spinal clinic appointment. Patients who were (1) tertiary referrals (consultants or ESP), (2) previous lost to follow-up, (3) did not attend (DNA), (4) did not respond to letter to attend appointment and (5) unable to attend spinal appointment were not included in the final analysis.

Subsequently, we followed up with the patients prospectively, examined their age, sex, MRI or further imaging request, clinic assessment and clinic assessor. The follow-up period was 6 months after the last day of the inclusion period (15th January 2016). Length of days between initial

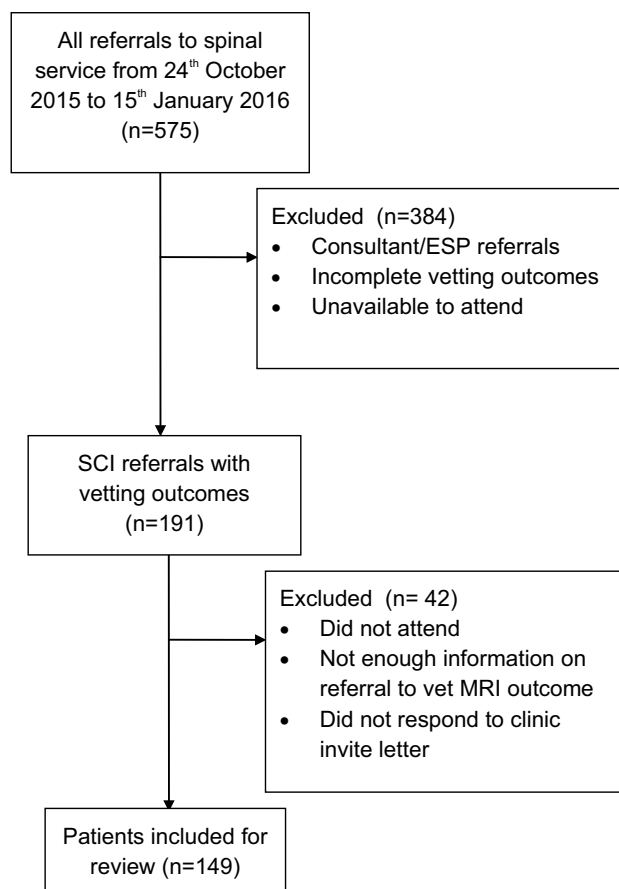


Fig. 1 Consort diagram detailing patients included for analysis during study period

Scottish Care Information (SCI) gateway referral, first clinic appointment and MRI appointments were recorded.

Statistical analysis

We produced a 2×2 contingency table to report the sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) of vetting outcomes and MRI request from first consultation. Data were analysed using GraphPad Prism version 7.00 for Windows, GraphPad Software, La Jolla, California, USA. This study did not require formal ethical approval (Table 1).

Results

At final follow-up, 149 patients were available for analysis, 101 females and 48 males with a mean age of 49 years (16–87 years). There were 125 routine, 21 urgent, and 3 ‘urgent-suspected cancer’ referrals. In total, 108 MRI scans were requested (72%). 89 patients who were classified as ‘likely’ to require an MRI went on to have an MRI scan

Table 1 Demographics, urgency of referral and wait times to first appointment and MRI

Patient characteristics	Total
No. of patients	149
Age, mean \pm SD	49 \pm 17 (range 16–87)
Sex, female, no. (%)	101 (68)
Urgency of referral (On SCI)	125 routine, 21 urgent, 3 urgent: suspected cancer
Time between SCI referral and first appointment (days)	Routine: 90 days (range 27–179) Urgent: 55 days (range 17–111) Urgent: suspected cancers 35 (range 8–69)
Time between SCI referral and MRI scan (days) ^a	Routine: 115 days (range 31–178) only 74 patients received an MRI Urgent: 76 days (range 35–151) only 11 patients received an MRI Urgent: suspected cancers 53 (range 25–80) ^a

^aFive were excluded due to DNA of MRI appointment; eight patients did not receive an appointment from radiology; one was excluded as was a NHS GGC staff and received MRI scan 1 day following SCI referral

(true positives) and 24 patients classified as ‘unlikely’ to require an MRI scan did not go on to have an MRI scan (true negatives). There were 19 false negatives (patients who were ‘unlikely’ to require an MRI at vetting but went on to have an MRI scan at clinic) and 17 false positives (patients who were ‘likely’ to require an MRI at vetting but did not have an MRI scan at clinic) at initial vetting, for which detailed analyses are shown on a pie chart in Fig. 2. The average length of time between SCI referral and first appointment for routine, urgent and urgent-suspected cancer referrals was 90, 55 and 35 days, respectively. The average length of time between SCI referral and MRI scan (if indicated) for routine, urgent and urgent-suspected cancer referrals was 115, 76 and 53 days respectively.

Table 2 shows the 2 \times 2 contingency table with PPV, NPV, specificity and sensitivity demonstrated in Table 3. The PPV of requesting MRI scans before first consultation was 84% and NPV was 56% with sensitivity and specificity being 82 and 59%, respectively. 76 patients were reviewed by a consultant and 70 patients were reviewed by ESPs, with 48 MRI scans requested by consultants and 40 MRI scans requested by ESPs.

Discussion

The increasing trend in spinal referrals has put tremendous stress on the outpatient as well as radiological services [2–7]. In the United Kingdom (UK), the delivery of spinal care varies throughout the country, with certain institutions requiring patients to have imaging prior to their first spinal clinic visit. This is based on historical practices, and is contrary to current NICE guidance if the MRI scans are requested by a non-specialist [10]. From this study, we have demonstrated that MRI scans can be effectively requested at initial vetting using primary care referrals with an 84%

positive predictive value. These results suggest that MRI scans can be requested early in the patient journey, thus decreasing the waiting times.

Literature has shown that open access to MRI scans for general practitioners (GPs) does not increase diagnostic yield nor discriminate suitable surgical candidates [8, 9]. However, recent evidence has shown that 94% of patients referred for MRI from GPs in the Netherlands have some degree of spinal pathology which the authors conclude its attribution to adherence to local guidelines [11]. Guidance-based request for further medical imaging is crucial as we see an increase of 10% per annum on radiological service on computer tomography (CT) and MRI scans [12]. When requested, medical imaging should add or change the clinical course of the patients especially in the group of low back pains, as MRI scans do not prognostically add to the recovery of this cohort [13]. Fundamentally, we recognise that this study did not address the prevalence of spinal pathologies from the MRI scans requested, which will be further evaluated in ongoing studies from our institution.

Currently, the waiting time from GP referral to spinal consultant review is increasing at the writing of this manuscript. Results from our study period in January 2016 suggest a 90-day waiting time prior to review for routine referrals, 55 days for urgent and 35 days for urgent-suspected cancer patients. Current NICE guidance on outpatient reviews for suspected cancer suggests the national target of review within 2 weeks [14]. Our study group has also shown that urgent-suspected cancer patients take an average of 53 days from GP referral to MRI scan, with return appointments far exceeding this.

The role of ESPs within orthopaedics, spinal services and the primary care setting is well established [2–5]. The Greater Glasgow Back Pain Service (GGBPS) is a physiotherapy-led service launched in 2002, which receives referrals from primary care or patient self-referral [6] in

Fig. 2 Reasons for false positive and false negative results at vetting

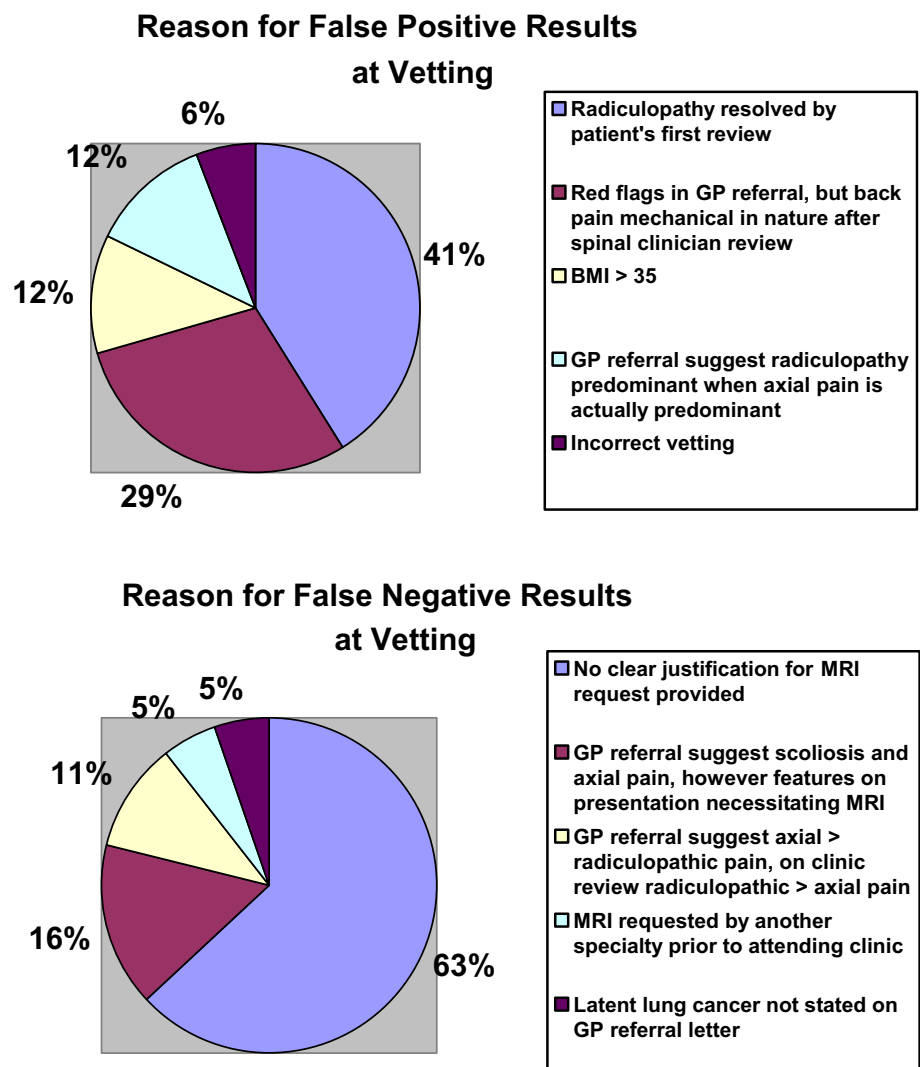


Table 2 MRI vetting and outcomes from initial referral

	MRI carried out	MRI not carried out	Total
MRI likely	89	17 ^b	106
MRI unlikely	19 ^a	24	43
Total	108	41	149

^aFalse negatives

^bFalse positives

Table 3 Specificity, sensitivity, PPV and NPV of ordering MRI at vetting referrals

Statistics	Value	Confidence intervals (%)
Sensitivity	82.4%	74.2–88.4
Specificity	58.5%	43.4–72.2
Positive predictive value	84.0%	75.8–89.7
Negative predictive value	55.8%	41.1–69.6
Likelihood ratio	1.99	

management of back pain within primary care sector. In the tertiary setting, the literature has shown that ESP-led clinics can decrease waiting times, improve MRI utilisation, and discriminate surgical candidates [2–5]. However, we recognised through analyses of false-negative results at vetting in Fig. 2 that 63% ($n=12$) did not have a clear indication of requesting an MRI scan, mainly at ESP-led clinics, which can be improved in the future with local MRI-requesting

guidelines. Besides that, patients that are triaged for ESP review are often radiculopathic in nature with lumbar disc herniation, often resolving at time of review and demonstrated in Fig. 2 with 41% ($n=7$) of false positives.

To cope with increasing referrals and pressure on the National Health Service, innovative service redesign within orthopaedics is supported with robust literature, with

examples of implementation in virtual fracture clinics (VFC) and arthroplasty [15–18]. This is also evident when utilising medical imaging such as those demonstrated in automation and machine learning in lumbar spine MRIs and orthopaedic imaging [19, 20] as it aids in speed and diagnoses of spinal pathology. Socioeconomic benefits have been demonstrated for both patient and the treating institution, as patients are not required to attend unnecessary clinic appointments [15–17]. In the present study, we have not examined the socioeconomic impact of requesting MRI scans based on the GP referral letters, as this is part of a larger ongoing study. Extended spinal vetting clinic has been introduced, with the aim of accurately triaging patients who require MRI scans prior to their first clinic consultation and early initiation of appropriate investigations, triaging red flag symptoms and assessment with no additional cost. It also provides insight into the use of MRI scans at an early stage of the spinal patient's journey. Through the analysis of our false positives and negatives (in Fig. 2), we can easily improve our PPV, NPV, sensitivity and specificity at initial vetting during extended spinal vetting clinic.

The strengths of this study include that it provides a prospective review of accuracy of MRI request from primary care referrals, while adhering to NICE guidance. Clinic assessors to a new spine clinic consisted of ESPs and four spinal orthopaedic consultants who were blinded to the vetting outcomes. False-positive and false-negative scans were further evaluated to improve PPV for future vetting. However, there were limitations to this paper. Due to the increasing waiting times of return clinics, nerve root blocks and surgery, patients were not followed up to the point of discharge through the spinal service. MRI results were not examined to evaluate the efficacy of MRI requesting between ESPs and spinal consultants.

Future research

We are currently reviewing the efficacy of phased introduction of the extended spinal vetting clinic with aims of full implementation into the West of Scotland spinal service to replace initial vetting. Socioeconomic benefits and cost comparisons of pathway will be further evaluated in collaboration with University of Strathclyde.

Conclusion

MRI scans can be effectively ordered based on the information provided by the primary care referral letter. Requesting MRI scans early in the patient journey can save considerable time, improve care, and deliver cost savings.

Compliance with ethical standards

Conflict of interest No conflict of interest. No funds were received in support of this work. No relevant financial activities outside the submitted work.

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