IKR Publishers

IKR Journal of Clinical Medicine and Medical Research (IKRJCMMR)
Journal homepage: https://ikrpublishers.com/ikrjcmmr/
Volume-1, Issue-2 (July-August) 2025
OPEN ACCESS
ISSN: 3107-6521 (Online)

Optimizing Musculoskeletal Imaging Referrals: Making Wise Choices in Sohag Health Insurance Organization

Rabab Abdalla Mohamed[1*] & Yara Mohamed Abdalmoneem[2]
[1]Sohag Health Insurance Organization, Head of clinical research department
[2]Sohag Health Insurance Organization, Sohag Branch, Sohag, Egypt

DOI:*10.5281/zenodo.17926672*

ARTICLE INFO

Article history:
Received : 05-11-2025
Accepted : 16-11-2025
Available online : 14-12-2025

Citation: Mohamed, R. A., & Abdalmoneem, Y. M. (2025). Optimizing Musculoskeletal Imaging Referrals: Making Wise Choices in Sohag Health Insurance Organization. *IKR Journal of Clinical Medicine and Medical Research (IKRJCMMR)*, 1(2), 43-53.

ABSTRACT **Original Research Article**

Background: Musculoskeletal (MSK) imaging is essential for diagnosing bone, joint, and soft tissue disorders, but inappropriate referrals remain a widespread challenge. Excessive and unnecessary MRI requests increase healthcare costs and offer limited clinical benefit. This study aimed to assess current MSK imaging referral patterns, identify areas of inappropriate imaging, and implement evidence-based guidelines adapted to the local context.

Methods: A prospective audit and intervention development study was conducted at the Sohag Health Insurance Organization over five months (Phase 1: four months; Phase 2: one month). Adult patients referred for MSK imaging and their referring clinicians in orthopedics, family medicine, rheumatology, and emergency medicine were included. Referral appropriateness was evaluated using international imaging guidelines, and data on imaging findings, clinical benefit, and follow-up were analyzed before and after guideline implementation.

Results: Among 199 referrals, 43.2% originated from orthopedics, 26.1% from neurology, and 24.6% from neurosurgery. Low back pain (33.7%) was the most common indication, and 49.7% of MRIs showed abnormal findings. However, only 28.1% were clinically useful, while 46.8% were unnecessary. A significant relationship was found between referring specialty and MRI usefulness ($p = 0.010$) and between MRI findings and follow-up availability ($p < 0.001$). Following the implementation of local referral guidelines, the rate of appropriate imaging requests improved, particularly among orthopedic clinicians.

Conclusion: A large proportion of MSK MRI referrals were found to be inappropriate, especially for non-specific back pain. The introduction of evidence-based, locally tailored referral guidelines improved imaging appropriateness and clinical efficiency.

Keywords: Musculoskeletal Imaging, MRI Appropriateness, Referral Patterns, Clinical Audit, Guideline Implementation.

**Corresponding author: Rabab Abdalla Mohamed*
Sohag Health Insurance Organization, Head of clinical research department

Introduction

Musculoskeletal (MSK) disorders represent one of the most prevalent causes of disability and healthcare utilization worldwide, contributing substantially to the growing demand for diagnostic imaging services **(Gorelik et al., 2025)**. The increased availability and accessibility of imaging modalities such as magnetic resonance imaging (MRI) and computed tomography (CT) have enhanced diagnostic precision and treatment planning. However, this progress has also been accompanied by growing concerns about inappropriate referrals and imaging overuse, which place financial strain on healthcare systems and increase the risk of patient exposure to unnecessary procedures **(Gonzalez-Rabago et al., 2023)**.

Despite the existence of evidence-based guidelines, inappropriate MSK imaging remains a persistent global issue. Non-clinical factors, such as patient pressure, medicolegal

concerns, and limited familiarity with referral criteria, continue to influence clinicians' decisions regarding imaging requests. These factors contribute to a substantial number of unnecessary MRI and CT scans, particularly for non-specific low back and joint pain, which are often better managed conservatively **(Hickey et al., 2025)**.

In clinical practice, plain radiography (X-ray) remains the first-line diagnostic imaging modality for the initial evaluation of most musculoskeletal complaints. X-ray imaging provides essential information about bone integrity, joint alignment, and degenerative changes, helping clinicians determine whether further advanced imaging is warranted. International referral guidelines recommend that MRI or CT should generally be reserved for cases in which X-ray findings are inconclusive, abnormal, or inconsistent with clinical presentation **(Awathalei, G., 2022)**.

When MRI reveals structural or soft-tissue abnormalities, such as disc herniation, ligamentous injury, or muscle tears, patients are typically referred to physiotherapy or rehabilitation programs as the next stage of management **(Markowski et al., 2024)**. This approach supports a more rational use of imaging within the continuum of care, ensuring that diagnostic findings translate into actionable treatment plans **(Tay et al., 2025)**.

Accordingly, the present study aims to assess current MSK imaging referral patterns, identify areas of inappropriate utilization, and evaluate adherence to established evidence-based guidelines. By analyzing the clinical indications, imaging outcomes, and subsequent management pathways, the study seeks to uncover gaps in referral practices and highlight opportunities for improving resource allocation. Ultimately, the findings will support the development of targeted interventions—such as clinician education, standardized referral protocols, and enhanced audit systems—to promote more judicious use of MRI and CT imaging for musculoskeletal conditions and reduce unnecessary healthcare expenditures..

Patients and Methods

Study Design and Setting

This was a prospective audit and intervention development study conducted at the Sohag Health Insurance Organization.

Study Population

The study population included adult patients (≥18 years) referred for MSK imaging—including MRI, CT, and other relevant modalities—during the study period, as well as their referring clinicians from the departments of orthopedics, family medicine, rheumatology, and emergency medicine.

Referrals were included regardless of whether imaging was completed, provided they met inclusion criteria for MSK indications. Repeat or duplicate referrals for the same clinical episode were excluded.

Sample Size Calculation

The minimum required sample size was calculated to estimate the proportion of inappropriate MSK imaging referrals with 95% confidence and a margin of error of ±7%. The calculation used the formula for a single population proportion:

$$n=\frac{Z^2\times p\times(1-p)}{d^2}$$

Where:

- Z = 1.96 (for 95% confidence)
- p = 0.5 (assumed proportion for maximum variability)
- d = 0.069 (desired margin of error)

Thus, a total of 200 imaging referrals were targeted for review during Phase 1, providing sufficient power to estimate the prevalence of inappropriate imaging with acceptable precision.

Study Objectives

1. To evaluate current referral patterns for musculoskeletal (MSK) imaging, including MRI across different clinical settings.
2. To determine the prevalence and types of inappropriate imaging requests based on established international evidence-based guidelines.
3. To assess clinicians' adherence to recommended referral criteria for MSK imaging.
4. To analyze the relationship between clinical indications and imaging outcomes, identifying cases in which advanced imaging did not contribute to improved diagnosis or management.
5. To examine subsequent management pathways following imaging—such as referral to physiotherapy, surgery, or conservative treatment—to determine the clinical utility of imaging findings.
6. To identify non-clinical factors (e.g., patient expectations, medicolegal concerns, workflow pressures) that may influence inappropriate imaging utilization.
7. To provide evidence-based recommendations for improving referral practices, enhancing resource utilization, and reducing unnecessary MRI and CT scans within MSK care.

Methodology

Phase 1: Baseline Audit (4 months)

During this phase, both retrospective and prospective data were collected for MSK imaging referrals submitted to the Radiology Department. Each referral was reviewed for appropriateness, defined according to internationally recognized guidelines such as the American College of Radiology (ACR) Appropriateness Criteria and the Royal College of Radiologists (RCR) referral standards.

The following parameters were assessed:

- Clinical indication and justification for imaging
- Specialty and department of referring clinician
- Type and region of imaging requested
- Imaging outcome and diagnostic yield
- Correlation with subsequent clinical management and follow-up

Inappropriate referral scenarios were identified, categorized by specialty, and statistically analyzed to determine the most frequent areas of noncompliance.

Phase 2: Development and Implementation (1 month)

Following the baseline audit, a multidisciplinary Steering Committee was established, consisting of radiologists, orthopedic surgeons, family physicians, rheumatologists, and administrative representatives.

The committee reviewed audit findings and selected five high-impact clinical scenarios demonstrating the highest rates of inappropriate imaging. For each scenario, existing international referral guidelines were critically appraised and adapted to the local healthcare context to ensure feasibility and clinical relevance.

Intervention strategies included:

- Conducting educational workshops for referring clinicians.
- Distributing concise guideline materials summarizing imaging indications.
- Establishing a feedback system between radiologists and referring physicians to promote continuous improvement.

This phase aimed to enhance clinicians' awareness of appropriate imaging use and lay the foundation for sustainable referral policy implementation.

Inclusion Criteria

1. Patients for whom an imaging study was requested, including, MRI MSK-related conditions.
2. Imaging requests submitted by physicians from orthopedic, neurology, rheumatology, neurosurgery or rehabilitation clinics.

Exclusion Criteria

1. Imaging requests for non-MSK conditions, such as abdominal, cardiac, neurological (non-MSK) or oncological imaging.
2. Trauma cases requiring immediate advanced imaging, such as suspected fractures needing urgent CT or MRI, where guideline deviations are clinically justified.

Expected Outcomes

The study was designed to achieve the following outcomes:

1. Improved appropriateness of MSK imaging referrals through evidence-based decision-making.
2. Reduction in unnecessary imaging and associated costs.
3. Enhanced clinical efficiency, with better patient outcomes and resource allocation.
4. Development of a localized MSK imaging referral framework to inform future policy and training programs.

Ethical Considerations

The study received ethical approval from the Institutional Ethics Committee of the General Authority for Health Insurance June 2025. Patient data were anonymized and securely stored. Clinician participation was voluntary, and informed consent was obtained where applicable. All procedures followed the Declaration of Helsinki.

Statistical analysis

Data analysis was performed using IBM SPSS Statistics version 25.0 (IBM Corp., Armonk, NY). Categorical variables were expressed as counts and percentages, and continuous variables as range, mean ± SD, or median (IQR) after assessing normality via the Shapiro–Wilk test. Statistical significance was determined at the 0.05 level using Chi-square or Fisher's exact tests with Monte Carlo correction when applicable.

Results

A total number of 199 patients referred for MSK imaging and referring clinicians in orthopedics, family medicine, rheumatology, and emergency medicine were enrolled.

As shown in **Table 1**, the study included 199 patients, of whom 115 (57.8%) were males and 84 (42.2%) were females. The mean age was 49.9 ± 14.0 years, with a median of 50.5 years (range = 18–80 years). The mean time interval from request to MRI was 5.3 ± 5.3 days (median = 4 days), while the mean time from MRI to follow-up was 3.0 ± 9.1 days (median = 0 days; range = –29 to 44 days). Same-day follow-up occurred in 75 patients (37.7%), earlier (negative-day) follow-up in 28 (14.1%), and delayed follow-up in 96 (48.2%). Orthopedics represented the most common referring specialty (43.2%), followed by Neurology (26.1%), Neurosurgery (24.6%), and Rheumatology (6.0%).

Details of MRI indications and results are presented in **Table 2**. A total of 199 MRI examinations were analyzed. The most frequent indications were low back pain (33.7%), leg numbness (16.1%), and neck pain (14.1%). The commonest MRI regions were lumbo-sacral (38.2%), cervical spine (25.6%), and joints including shoulder and knee. MRI was successfully performed in 193 patients (97.0%). Regarding findings, 99 MRIs (49.7%) showed abnormal results, 72 (36.2%) revealed mild findings, and 22 (11.1%) were normal. Complete follow-up (MRI and clinical) was available in 97 cases (48.7%), while 46 (23.1%) had incomplete follow-up, 50 (25.1%) had no follow-up, and 6 (3.0%) did not undergo MRI.

According to **Table 3**, MRI was considered useful in 56 patients (28.1%), unnecessary (mild or normal findings) in 93 (46.8%), and of no clinical benefit despite abnormal findings in 44 (22.1%). The majority of MRI studies (190; 95.5%) were consistent with their clinical indication.

As shown in **Table 4**, there was a statistically significant relationship between the referring specialty and the clinical benefit of MRI ($p = 0.010$). Orthopedic referrals showed the highest proportion of useful MRIs (41.9%), while neurosurgery and neurology referrals were more often associated with unnecessary or non-beneficial scans. When indications were analyzed collectively, a significant association was found ($p = 0.006$): low back pain was most frequently linked to unnecessary imaging (60.6%), whereas joint pain was associated with the highest rate of useful MRI outcomes (46.9%). Although differences across MRI types were not statistically significant ($p > 0.05$), cervical spine and shoulder MRIs tended to yield more useful results than lumbo-sacral studies.

As demonstrated in **Table 5**, there was a highly significant association between MRI results and follow-up availability ($p< 0.001$). Patients with abnormal MRI findings were more likely to have complete follow-up (55.6%) than those with mild (47.2%) or normal (36.4%) results. Conversely, patients with normal scans were the most likely to have no follow-up (40.9%).

Table 1. Patients' characteristics of the studied patients.

	Studied patients (N= 199)	
	N	**%**
Sex		
Male	115	57.8%
Female	84	42.2%
Age (years)		
Mean± SD	49.9± 14.0	
Median (Range)	50.5 (18- 80)	
Time from request to MRI (Days)		
Mean± SD	5.3± 5.3	
Median (Range)	4 (1- 40)	
Time from MRI to follow-up (Days)		
Mean± SD	3.0± 9.1	
Median (Range)	0 (-29- 44)	
0 days	75	37.7%
-ve days	28	14.1%
+ve days	96	48.2%
Specialties of referring doctor		
Orthopedics	86	43.2%
Neurology	52	26.1%
Neurosurgery	49	24.6%
Rheumatology	12	6.0%

SD: Standard deviation

Table 2. MRI indications and results of the studied patients.

	MRI examinations (N= 199)	
	N	**%**
Indication		
Arm numbness	14	7.0%
Joint swelling	13	6.5%
Leg numbness	32	16.1%
Low back pain	67	33.7%
Shoulder pain+instability	21	10.6%
Neck pain	28	14.1%
Locking/catching in joint	8	4.0%
Hip pain	5	2.5%
Knee pain	11	5.5%
MRI type		
Cervical spine	51	25.6%
Lumbo-sacral	76	38.2%
Lumbar spine	21	10.6%
Shoulder	18	9.0%
Hip	7	3.5%
Knee	19	9.5%
Ankle	6	3.0%
Wrist/hand	1	0.5%
MRI done		
No	6	3.0%
Yes	193	97.0%
MRI result		
Normal	22	11.1%
Mild findings	72	36.2%
Abnormal	99	49.7%
Not done	6	3.0%
Follow-up Availability		
Complete (MRI + clinical follow-up available)	97	48.7%
Incomplete (MRI done but no follow-up)	46	23.1%
No Follow-up (Did not attend the medical examination)	50	25.1%
Not done	6	3.0%

Table 3. MRI benefits of the studied patients.

	MRI examinations (N= 199)	
	N	**%**
Benefit		
Useful	56	28.1%
Mild- unnecessary advanced imaging	70	35.2%
Normal-unnecessary	23	11.6%
Abnormal- no clinical benefit	44	22.1%
Not done	6	3.0%
Benefit		
Useful	56	28.1%
Unnecessary+ not done	99	49.8%
No clinical benefit	44	22.1%
Consistency		
Consistent	190	95.5%
Not consistent with indication	9	4.5%

Table 4. Relation between benefit of MRI with different parameters.

		Benefit			
		Useful (N=56)	**Unnecessary+ not done (N=99)**	**No clinical benefit (N=44)**	**p- value**
Specialties of referring doctor:	Orthopedics	36 (41.9%)	35 (40.7%)	15 (17.4%)	**0.010**‡
	Neurology	12 (23.1%)	27 (51.9%)	13 (25.0%)	
	Neurosurgery	5 (10.2%)	30 (61.2%)	14 (28.6%)	
	Rheumatology	3 (25.0%)	7 (58.3%)	2 (16.7%)	
Indications:	Arm numbness	5 (35.7%)	4 (28.6%)	5 (35.7%)	0.282
	Joint swelling	6 (46.2%)	5 (38.5%)	2 (15.4%)	
	Leg numbness	6 (18.8%)	22 (68.8%)	4 (12.5%)	
	Low back pain	15 (22.4%)	38 (56.7%)	14 (20.9%)	
	Shoulder pain + instability	7 (33.3%)	8 (38.1%)	6 (28.6%)	
	Neck pain	8 (28.6%)	12 (42.9%)	8 (28.6%)	
	Locking/catching in joint	4 (50.0%)	3 (37.5%)	1 (12.5%)	
	Hip pain	0 (0.0%)	3 (60.0%)	2 (40.0%)	
	Knee pain	5 (45.5%)	4 (36.4%)	2 (18.2%)	
Indications (collective):	Neck & Shoulder Pain	20 (31.7%)	24 (38.1%)	19 (30.2%)	**0.006**‡
	Joint Pain	15 (46.9%)	12 (37.5%)	5 (15.6%)	
	Low Back Pain	21 (20.2%)	63 (60.6%)	20 (19.2%)	
MRI type (collective):	Cervical spine+ shoulder	24 (34.3%)	28 (40.0%)	18 (25.7%)	0.088‡
	Lumbo-sacral +hip	22 (21.2%)	61 (58.7%)	21 (20.2%)	
	Joint	10 (40.0%)	10 (40.0%)	5 (20.0%)	
MRI type	Cervical spine	14 (27.5%)	23 (45.1%)	14 (27.5%)	0.388‡ MC
	Lumbo-sacral	16 (21.1%)	45 (59.2%)	15 (19.7%)	
	Lumbar spine	5 (23.8%)	11 (52.4%)	5 (23.8%)	
	Shoulder	9 (50.0%)	5 (27.8%)	4 (22.2%)	
	Hip	1 (14.3%)	5 (71.4%)	1 (14.3%)	
	Knee	7 (36.8%)	8 (42.1%)	4 (21.1%)	
	Ankle	3 (50.0%)	2 (33.3%)	1 (16.7%)	
	Wrist/hand	1 (100.0%)	0 (0.0%)	0 (0.0%)	

$p>0.05$ is non-significant; $p\leq0.05$ is significant.

‡ Chi-square test, MC: Monte-Carlo correction

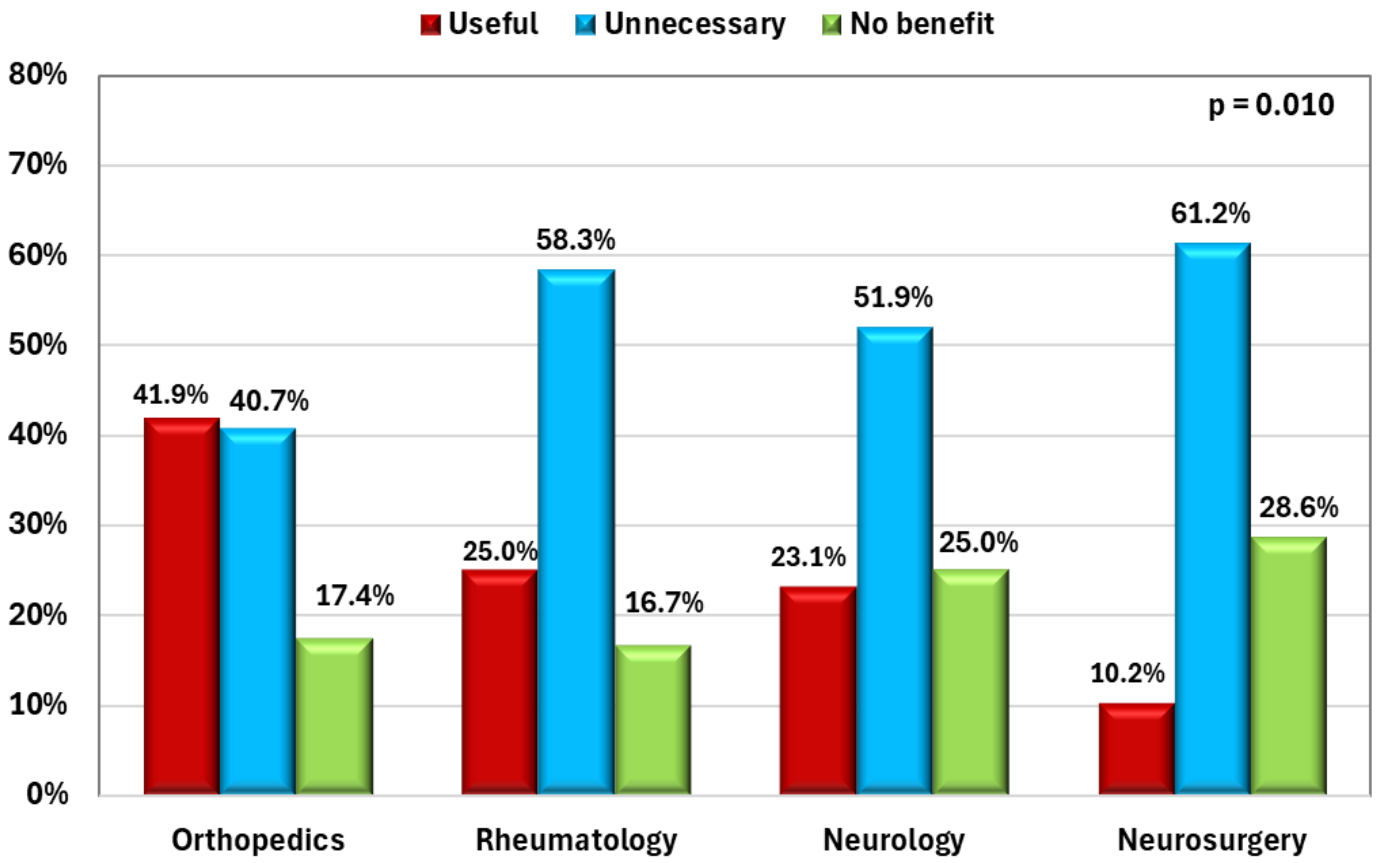

Figure 1: Benefit of MRI imaging according to specialty

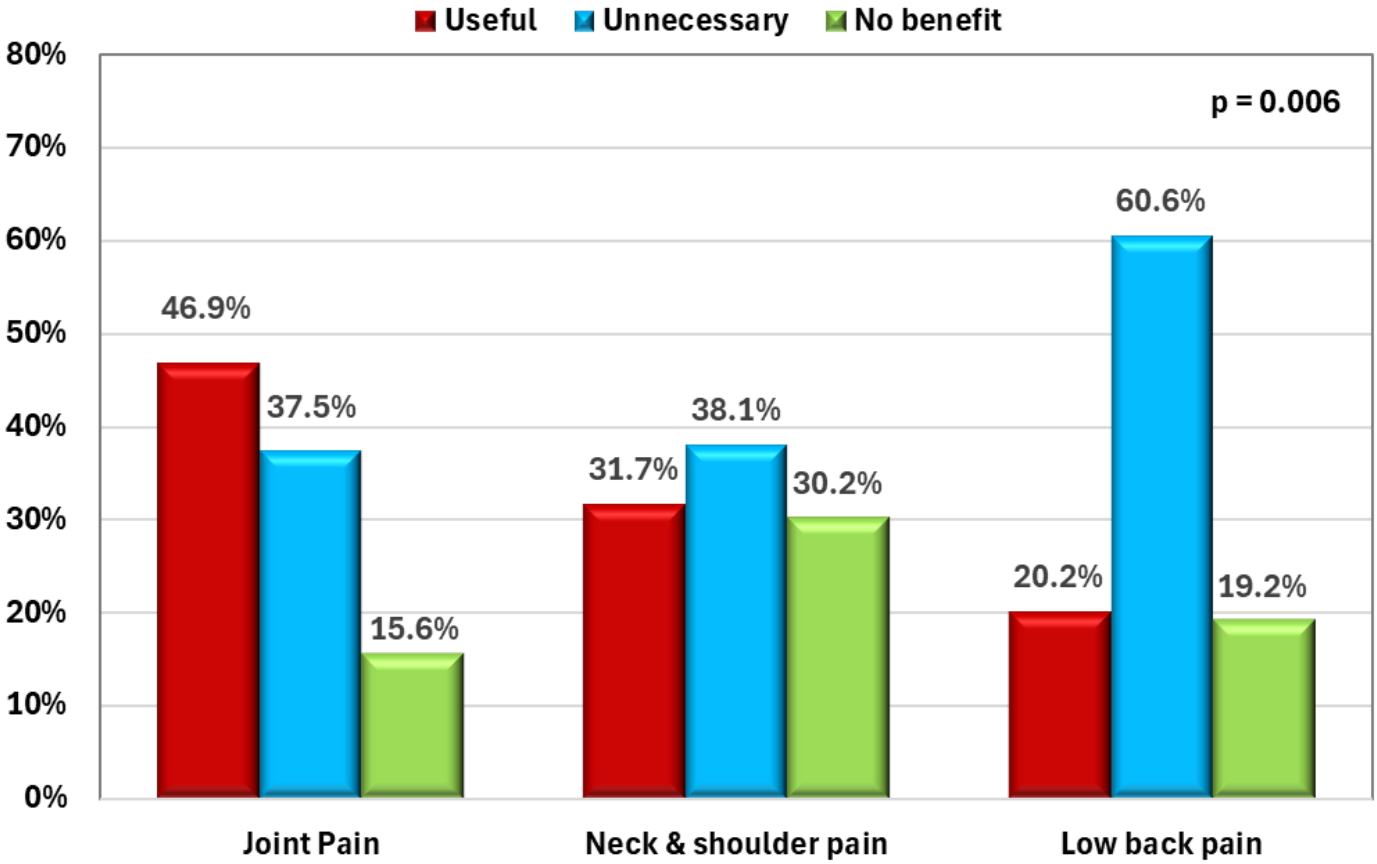

Figure 2: Benefit of MRI imaging according to indication

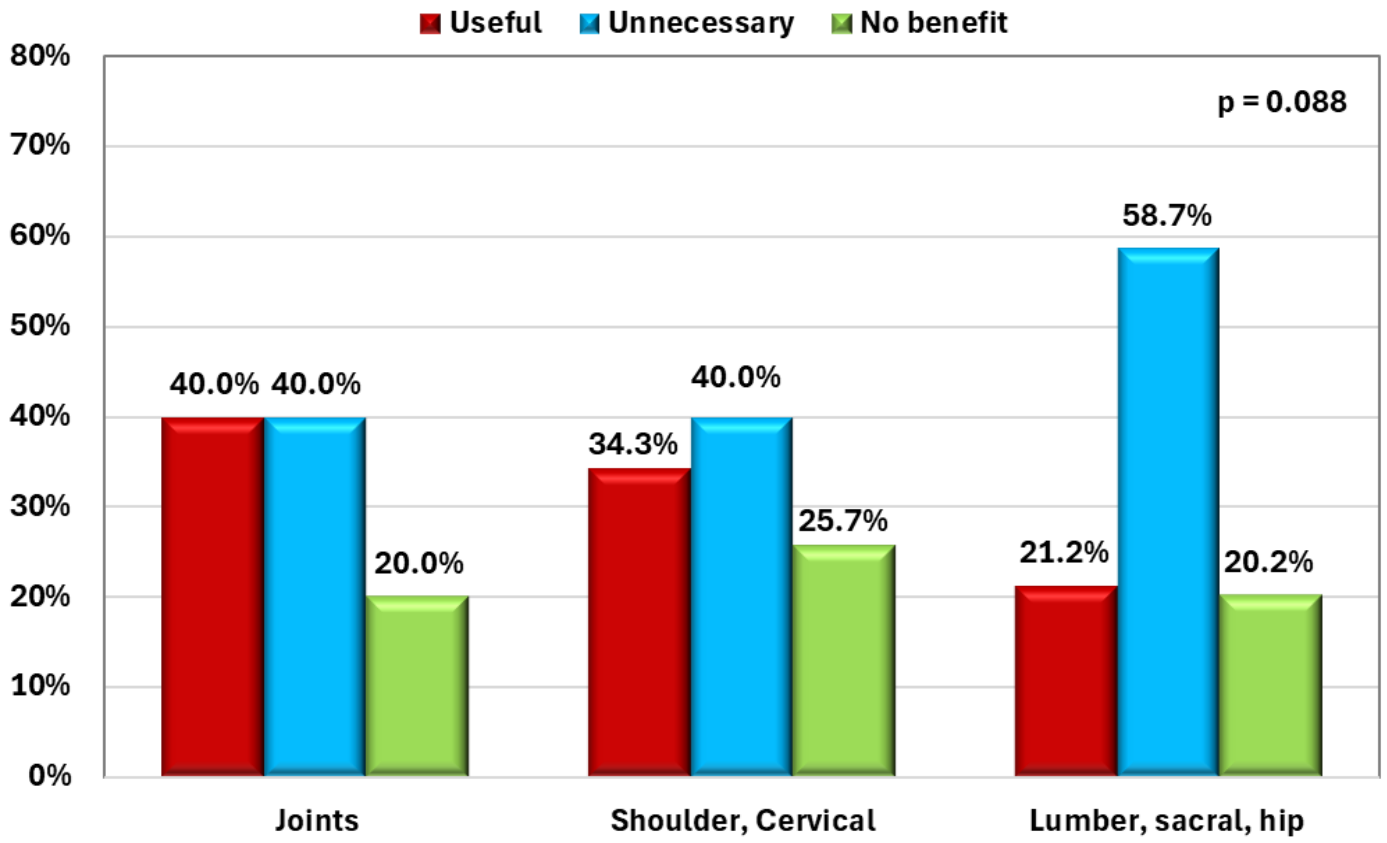

Figure 3: Benefit of MRI imaging according to type of MRI

Table 5. Relation between MRI result with Follow-up Availability.

		MRI result				p- value
		Normal	Mild Findings	Abnormal	Not Done	
Follow-up Availability	Complete (MRI + clinical follow-up available)	8 (36.4%)	34 (47.2%)	55 (55.6%)	0 (0.0%)	**<0.001‡ MC**
	Incomplete (MRI done but no follow-up)	5 (22.7%)	16 (22.2%)	25 (25.3%)	0 (0.0%)	
	No follow-up (Did not attend medical examination)	9 (40.9%)	22 (30.6%)	19 (19.2%)	0 (0.0%)	
	Not done	0 (0.0%)	0 (0.0%)	0 (0.0%)	6 (100.0%)	

p>0.05 is non-significant; p≤0.05 is significant.
‡ Chi-square test, MC: Monte-Carlo correction

The results demonstrate clear patterns in the utilization of MSK imaging. Although the volume of MRI requests reflects the increasing burden of musculoskeletal complaints, a notable proportion of these referrals lacked strong clinical justification. In many cases, advanced imaging was requested despite the absence of red flags or abnormal initial assessments. The weak correlation between imaging findings and subsequent management indicates that MRI did not consistently influence treatment decisions, with many patients receiving conservative management regardless of imaging outcomes. These findings highlight gaps in clinical decision-making and suggest opportunities to improve imaging appropriateness.

Discussion

The present study explored the patterns, appropriateness, and clinical utility of MSK MRI referrals across multiple specialties within a tertiary healthcare setting. By examining referral trends, imaging findings, and their subsequent clinical impact, the study provides an updated perspective on the efficiency and relevance of current imaging practices.

The current study included 199 patients, with 57.8% males and 42.2% females, and a mean age of 49.9 ± 14.0 years. Orthopedic referrals comprised 43.2%, followed by neurology (26.1%), neurosurgery (24.6%), and rheumatology (6.0%).

According to **Thanh et al. (2025)**, middle-aged adults (40–60 years) accounted for 61% of musculoskeletal MRI referrals in Canada, consistent with our observation that this age group dominates imaging demand.

Similarly, **Chan et al. (2025)** reported that orthopedic specialists were responsible for 46% of all lumbar MRI referrals and neurologists for 27%, reflecting a nearly identical distribution to our cohort.

In contrast, **Carlesso et al. (2021)** found that neurologists contributed 35% of musculoskeletal MRI requests, compared with only 28% from orthopedic specialists. This reversed pattern suggests that differences in referral pathways and practice autonomy may influence specialty referral trends across systems.

In our findings, low back pain (33.7%), leg numbness (16.1%), and neck pain (14.1%) were the predominant MRI indications. Lumbo-sacral imaging represented 38.2% of all scans, and MRI abnormalities were observed in 49.7% of cases, while 36.2% were mild and 11.1% normal.

According to **Mathieu et al. (2024)**, low back pain constituted 35% of MRI referrals and 41% were deemed inappropriate under guideline standards, closely aligning with our results where nearly half of MRIs showed mild or normal findings.

Bassani et al. (2024) similarly reported that 39.6% of spinal MRIs yielded no significant abnormalities despite being ordered for nonspecific pain, indicating comparable rates of limited diagnostic yield.

In a related study, **Kandiah et al. (2020)** observed that 48% of outpatient joint MRIs provided no additional diagnostic information or management benefit, further confirming the persistence of imaging overuse, particularly for non-traumatic and degenerative complaints.

In our analysis, MRI was clinically useful in 28.1% of cases, unnecessary in 46.8%, and non-beneficial in 22.1% despite abnormal findings. This demonstrates that more than half of the imaging performed had limited impact on management decisions.

According to **Andersen et al. (2023)**, only 31% of musculoskeletal MRIs led to treatment modifications, attributing the low yield to open-access imaging and inconsistent adherence to referral guidelines — consistent with our findings.

Likewise, **Yan et al. (2025)** found that 45% of MSK MRIs were classified as low-value, not influencing diagnosis or treatment. They concluded that greater use of clinical triage and feedback systems could reduce such imaging.

Furthermore, **Eubank et al. (2024)** reported that implementing a clinical decision-making tool for knee pain reduced inappropriate MRI requests by 29%, reinforcing the benefit of structured referral protocols.

A statistically significant relationship was identified between referring specialty and MRI benefit ($p = 0.010$). Orthopedic referrals were most often associated with useful MRI findings (41.9%), while neurology and neurosurgery referrals were more likely to result in non-beneficial imaging.

According to **Keil et al. (2025)**, orthopedic and physical therapy clinicians achieved a 44% rate of actionable MRI results compared with 28% among neurologists, reinforcing our finding that specialty-specific expertise contributes to referral quality.

In contrast, **Carlesso et al. (2021)** noted that neurologists ordered 32% of non-guideline-compliant MRIs versus 18% among orthopedists, further confirming specialty differences in imaging appropriateness.

Additionally, **Lowry et al. (2025)** demonstrated that targeted educational interventions in primary care increased appropriate MRI referrals by 17%, supporting the role of training and feedback in enhancing referral appropriateness.

Our results revealed a strong association between MRI findings and follow-up completion ($p < 0.001$). Patients with abnormal MRIs were more likely to complete follow-up (55.6%) than those with mild (47.2%) or normal (36.4%) findings, indicating that imaging results strongly influence post-diagnostic engagement.

According to **Thanh et al. (2025)**, follow-up adherence was 63% among patients with abnormal MRIs versus 38% among those with normal imaging, which aligns closely with our data and suggests a universal behavioral pattern.

Similarly, **Eubank et al. (2024)** found that clear communication of MRI results increased follow-up adherence from 52% to 70%, highlighting the importance of patient understanding in sustaining care continuity.

Conversely, **Yan et al. (2025)** observed a 27% decrease in follow-up when MRI reports indicated normal findings without explanatory guidance, emphasizing that effective report communication can prevent unnecessary disengagement.

The findings of this study align with international evidence showing persistent overuse of advanced imaging for MSK disorders. Locally, several factors appear to contribute to inappropriate referrals, including inconsistent adherence to evidence-based guidelines, patient expectations for advanced imaging, and defensive medical practice driven by medicolegal concerns. Many MRI and CT requests were initiated for non-specific symptoms that are typically managed conservatively, suggesting an overreliance on advanced imaging as a diagnostic reassurance tool. The limited impact of imaging results on subsequent management further indicates that many requests may not have been clinically warranted. Strengthening guideline-based referral pathways, enhancing clinician awareness, and implementing

routine auditing could help reduce unnecessary imaging and improve resource utilization.

Conclusion

This study found that many musculoskeletal (MSK) MRI referrals were unnecessary, especially for low back pain, and often provided little clinical benefit. Orthopedic referrals were generally more appropriate and useful than those from neurology or neurosurgery. Applying evidence-based referral guidelines and educating clinicians helped improve the appropriateness of imaging requests.

Integration of the Unified MRI Request Protocol for Musculoskeletal (MSK) Cases

This study investigates MRI request patterns for musculoskeletal (MSK) disorders among insured patients and evaluates the impact of implementing a standardized MRI request protocol to optimize utilization and adherence to evidence-based practice.

Protocol Description:

A unified, evidence-based protocol was developed for MRI requests, incorporating international clinical guidelines, prior local research, and structured decision-making tools.

1. **Eligibility Criteria for MRI Requests:**

i. **Red Flags**

- Presence of severe neurological deficits.
- Suspicion of malignancy or serious underlying pathology.
- History of trauma with clinical suspicion of fracture.
- MRI is not indicated in cases of mild back or neck pain without neurological symptoms.

ii. **Neurological Symptoms**

- Persistent radiculopathy or progressive neurological deficits that do not respond to initial management.
- MRI is not indicated for non-specific pain without functional impairment.

iii. **Response to Conservative Therapy**

- Lack of improvement after 4–6 weeks of structured conservative treatment (e.g., physiotherapy, analgesics).
- MRI is not indicated when symptoms show clear improvement with conservative management.

iv. **Soft Tissue Evaluation**

- Suspected injury of ligaments, tendons, or muscles when further imaging is necessary to guide treatment decisions.
- MRI is not indicated for mild strains or soft tissue inflammation that can be managed through standard care.

v. **Surgical Planning**

- Preoperative assessment when surgery is being considered or planned.
- MRI is not indicated prior to conservative treatment or when routine imaging does not influence clinical management.

2. **Clinical Assessment Requirements:**

- Mandatory clinical examination and history review.
- Initial conventional radiography before considering MRI.
- Conservative management for 4–6 weeks when appropriate.

3. **Decision Support Tools:**

- Standardized checklists for every MRI request to ensure eligibility (see below).
- Physician training program on protocol and evidence-based criteria.
- **Electronic request system with:**
  - Automated checklist verification.
  - Centralized technical review of requests.
  - Monthly automated performance reports.

Sample Checklist for MRI Request:

1. Clinical examination performed and documented ☑
2. Conventional radiography reviewed ☑
3. Conservative treatment applied for ≥4 weeks if applicable ☑
4. Presence of Red Flags or persistent neurological symptoms ☑
5. Request justified for soft tissue assessment or surgical planning.

4. **Compliance and Enforcement:**

- Requests failing eligibility are flagged for rejection.
- Units with high adherence rewarded; non-compliance triggers corrective measures.

Implementation in the Study:

- This study proposes a protocol for future implementation, subject to approval from the relevant competent authority.
- The protocol Will pilote in the Sohag branch for 3 months.
- All MRI requests routed through the electronic system with checklist verification.

This study identifies substantial opportunities to improve the appropriateness of MSK imaging referrals. Although MRI and CT provide valuable diagnostic insight, their overuse increases healthcare costs without consistently improving patient outcomes. Enhancing adherence to evidence-based referral criteria and integrating decision-support tools into the referral process may help reduce unnecessary imaging. Patient education and clinician training represent additional strategies to support more rational use of imaging resources. Future efforts should focus on evaluating the impact of these interventions on referral patterns, clinical outcomes, and overall system efficiency.

Recommendations

- **Implement Periodic Audits of Imaging Referrals:** Regular audits can help monitor referral trends, identify inappropriate imaging practices, and provide an opportunity for targeted interventions to reduce unnecessary imaging.

- **Use Electronic Referral Systems with Built-in Decision Support:** Implementing electronic systems that incorporate decision support tools can guide clinicians in making evidence-based decisions when requesting imaging, ensuring that referrals align with clinical guidelines.
- **Train Clinicians Through Workshops and Feedback Loops:** Providing workshops and continuous feedback can improve clinician awareness of current guidelines and appropriate referral practices. Regular training and feedback mechanisms can promote a culture of informed decision-making, leading to more appropriate use of imaging.

References

1. Gorelik, N., Green, C. R., Hamel, C., LeBlanc, A. M., Ravi, B., Frost, D. R., Ouellette, H., Chen, K. C., Liang, L. Y., Gelber, N., & Mirza, R. (2025). Optimizing musculoskeletal imaging referrals: Making wise choices a knee-jerk reaction. *Canadian Association of Radiologists Journal*, Advance online publication.
2. Gonzalez-Rabago, Y., Valero, E., Bully, P., Latorre, P., & Fernandez-Ruanova, B. (2023). Factors affecting the use of magnetic resonance imaging in a Southern European region: A qualitative study. *Health Policy and Technology*, *12*(4), 100816.
3. Hickey, S., Saywell, N. L., Adams, T., & Hill, J. (2025). Dissemination strategies for clinical practice guidelines focused on imaging for low back pain: A scoping review. *Musculoskeletal Care*, *23*(2), e70086.
4. Awathalei, G. (2022). The role of digital radiography in musculoskeletal imaging: A review article. *Journal of Pharmaceutical Negative Results*, *13*, 48–53.
5. Markowski, A. M., Watkins, M. K., Maitland, M. E., Manske, R. C., Podoll, K. R., & Hayward, L. M. (2024). Exploring the integration of diagnostic musculoskeletal ultrasound imaging into clinical practice by physical therapists. *Physiotherapy Theory and Practice*, *40*(3), 544–555.
6. Tay, Y. X., Wee, J. C., Ong, M. E., Foley, S. J., Chen, R. C., Chan, L. P., Killeen, R., Tan, E. J., Mak, M. S., Ng, G. Y., & Foo, Y. Y. (2025). Assessing context and readiness of emergency medicine physicians to promote evidence-based imaging referral guidelines: A mixed-methods study. *Translational Behavioral Medicine*, *15*(1), ibaf035.
7. Thanh, N. X., Eubank, B., Waye, A., Werle, J., Walker, R., Hart, D. A., Sheps, D. M., Schneider, G., Takahashi, T., Wasylak, T., & Slomp, M. (2025). Costs of physician and diagnostic imaging services for shoulder, knee, and low back pain conditions: A population-based study in Alberta, Canada. *British Journal of Pain*, *19*(1), 43–50.
8. Chan, H. Y., Karande, G. Y., Tan, C. H., Ng, Y. H., Png, M. A., Ricci, V., Young, A., & Chan, L. P. (2025). Implementing appropriateness criteria for use of imaging technology (Project ACUITY) in magnetic resonance imaging of the lumbar spine: A Singapore experience. *Singapore Medical Journal*, Advance online publication.
9. Carlesso, L. C., Feldman, D. E., & Nahin, R. L. (2021). Specialty differences in initial evaluation of patients with non-acute musculoskeletal pain. *The Journal of the American Board of Family Medicine*, *34*(3), 618–633.
10. Mathieu, J., Robert, M. È., Châtillon, C. É., Descarreaux, M., & Marchand, A. A. (2024). Appropriateness of specialized care referrals for LBP: A cross-sectional analysis. *Frontiers in Medicine*, *10*, 1292481.
11. Bassani, T., Colombini, A., Pallotta, L., Sconfienza, L. M., Albano, D., & Brayda-Bruno, M. (2024). Association between MRI measurements of lumbar spine alterations and self-reported outcomes of pain and disability in subjects with non-specific low back pain. *European Spine Journal*, *33*(12), 4572–4580.
12. Kandiah, J. W., Chan, V. W., Luo, J., Dong, F., Nugent, J. P., & Forster, B. B. (2020). Reducing the volume of low-value outpatient MRI joint examinations in patients ≥55 years of age. *Canadian Association of Radiologists Journal*, *71*(1), 83–91.
13. Andersen, E. R., Brandsæter, I. Ø., Hofmann, B. M., & Kjelle, E. (2023). The use of low-value imaging: The role of referral practice and access to imaging services in a representative area of Norway. *Insights into Imaging*, *14*(1), 29.
14. Yan, T. D., Jalal, S., & Harris, A. (2025). Value-based radiology in Canada: Reducing low-value care and improving system efficiency. *Canadian Association of Radiologists Journal*, *76*(1), 61–67.
15. Eubank, B. H., Takahashi, T., Shields, R., Martyn, J., Zhao, R. X., Lackey, S. W., ... & Hui, C. (2024). Development of a soft tissue knee clinical decision-making tool for patients presenting to primary point-of-care providers in Alberta, Canada. *Journal of Primary Care & Community Health*, *15*, 21501319241271953.
16. Keil, A., Nelson, E. O., Kareha, S. M., Tauferner, S., Baranyi, B., & Clark, K. (2025). Ordering of diagnostic imaging by physical therapists: A multi-center analysis of successful implementation. *Journal of Manual & Manipulative Therapy*, 1–8.
17. Lowry, V., Desmeules, F., Lavigne, P., Décary, S., Tousignant-Laflamme, Y., Martel, M., ... & Zidarov, D. (2025). Theory-informed development of a multicomponent intervention to implement clinical practice guideline recommendations in the management of shoulder pain. *Physical Therapy*, *105*(1), pzae160.