

Improving Appropriate use of MRI Lumbar Spine: SGH Experience

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- Background
 - ACUITy project
 - ACE guidelines
 - Data collection and Analysis
 - Results

Low back pain

- Acute low back is a leading cause of years lived with disability, in the USA
- Globally, high prevalence of 12-33%, particularly in patients aged 40-80 years old
- Accounts for approximately 3% of visits to the ED in the USA
- Uncomplicated acute low back pain with or without radiculopathy is benign, self-limiting condition which does not warrant imaging

Expert Panel on Neurological Imaging; Hutchins TA, Peckham M, Shah LM, Parsons MS, Agarwal V, Boulter DJ, Burns J, Cassidy RC, Davis MA, Holly LT, Hunt CH, Khan MA, Moritani T, Ortiz AO, O'Toole JE, Powers WJ, Promes SB, Reitman C, Shah VN, Singh S, Timpone VM, Corey AS. ACR Appropriateness Criteria® Low Back Pain: 2021 Update. J Am Coll Radiol. 2021 Nov;18(11S):S361-S379. doi: 10.1016/j.jacr.2021.08.002. PMID: 34794594.

Hoy D, Bain C, Williams G, March L, Brooks P, Blyth F, Woolf A, Vos T, Buchbinder R. A systematic review of the global prevalence of low back pain. Arthritis Rheum. 2012 Jun;64(6):2028-37. doi: 10.1002/art.34347. Epub 2012 Jan 9. PMID: 22231424.

Current practices



Many patients with low back pain receive routine spinal imaging (XR, CT, MR) despite current recommendations



Routine imaging is **not** associated with better clinical outcomes.



Overuse of imaging also contributes to the high and growing costs associated with low back pain.



Addressing inefficiencies in diagnostic testing could minimize potential harms to patients and have a large effect on use of resources by reducing both direct and downstream costs.

Chou R, Qaseem A, Owens DK, Shekelle P, Clinical Guidelines Committee of the American College of P. Diagnostic imaging for low back pain: advice for high-value health care from the American College of Physicians. *Ann Intern Med* 2011;154:181-9.

Imaging not always the answer.

- Wide range of lumbar disc abnormalities are often seen in asymptomatic patients.
- Increased prevalence of degenerative spine findings with age, while these patients remain asymptomatic.
- Suggesting that imaging findings may not necessarily equate to clinically significant symptoms.

Boden SD, Davis DO, Dina TS, Patronas NJ, Wiesel SW. Abnormal magnetic-resonance scans of the lumbar spine in asymptomatic subjects. A prospective investigation. J Bone Joint Surg Am 1990;72:403-8.
Brinjikji W, Luetmer PH, Comstock B, et al. Systematic literature review of imaging features of spinal degeneration in asymptomatic populations. AJNR Am J Neuroradiol 2015;36:811-6. Autio RA, Karppinen J, Niinimäki J, et al. Determinants of spontaneous resorption of intervertebral disc herniations. Spine (Phila Pa 1976) 2006;31:1247-52.

More imaging can be detrimental...



Risks associated with routine imaging include unnecessary radiation exposure and patient labeling.



The labeling phenomenon of patients with low back pain has been studied and shown to worsen patients' sense of well-being.



Increase rate of imaging associated with increase rate of surgery.

Shubha SV, Deyo RA, Berger ZD. Application of “less is MNore” to Low Back Pain. Arch Intern Med 2012;172(13):1016-1020.

Modic MT, Obuchowski NS, Ross JS et al. Acute low back pain and radiculopathy: MR imaging findings and their prognostic role and effect on outcome. Radiology 2005;237 (2):597-604.

Current ACR recommendations

- Diagnostic imaging is indicated for patients with low back pain only if they have severe progressive neurologic deficits or signs or symptoms that suggest a serious or specific underlying condition.

Table 1. Red Flags: Indications of a more complicated status include back pain/radiculopathy in the following settings (adapted from Bigos et al [8]).

Red Flag	Potential Underlying Condition as Cause of LBP
<ul style="list-style-type: none"> History of cancer Unexplained weight loss Immunosuppression Urinary infection Intravenous drug use Prolonged use of corticosteroids Back pain not improved with conservative management 	<ul style="list-style-type: none"> Cancer or infection
<ul style="list-style-type: none"> History of significant trauma Minor fall or heavy lift in a potentially osteoporotic or elderly individual Prolonged use of steroids 	<ul style="list-style-type: none"> Spinal fracture
<ul style="list-style-type: none"> Acute onset of urinary retention or overflow incontinence Loss of anal sphincter tone or fecal incontinence Saddle anesthesia Bilateral or progressive weakness in the lower limbs 	<ul style="list-style-type: none"> Cauda equina syndrome or other severe neurologic condition

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Project : ACUiTy

- A/Prof Tan Cher Heng (Senior Consultant, Diagnostic Radiology, TTSH) started the project “**Appropriateness Criteria for Use of Imaging Technology (ACUiTy)**”
 - **Aim:** To guide the appropriate use of imaging technology through the formulation and implementation of guidelines adapted for use in the local context
 - **Background:** The number of imaging procedures across various care settings performed grew on average by 8% per year between 2014 and 2016. Of note, CTs and MRIs reported higher growth rates of 9% and 13% respectively (see Table below).

Year	2014	2015	2016	CAGR
MRI Scans	113,790	130,977	144,916	12.85%
CT Scans	232,201	251,181	276,834	9.19%
Ultrasound	296,120	310,947	336,451	6.59%
XRy	1,532,407	1,613,529	1,762,985	7.26%
Others*	201,084	215,062	234,892	8.08%
TOTAL	2,375,602	2,521,696	2,756,078	7.71%

*(includes image guided intervention, mammography)

SGH ACUiTy implementation workgroup

ACR Appropriateness Criteria® Low Back Pain:

Expert Panel on Neur
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Judah Burns, MD^g, R.
Christopher H. Hunt, I
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Susan B. Promes, MD,
Vincent M. Timpone,

VA/DoD Clinical Practice Guideline: Diagnosis and Treatment of Low Back Pain

Sanjog S. Pangarkar, MD^{1,2}, Daniel G. Kang, MAJ, MD³, Friedhelm Sandbrink, MD¹, Adam Bevevino, MAJ, MD³, Kirsten Tillisch, MD¹, Lisa Konitzer, LTC, PT, DSc, OCS, FAAOMPT³, and James Sall, PhD, FNP-BC³

¹United States Department of Veterans Affairs, Washington, DC, USA; ²VA Greater Los Angeles Healthcare System, Los Angeles, CA, USA; ³United States Department of Defense, Washington, DC, USA.

DESCRIPTION: In September 2017, the U.S. Department of Veterans Affairs (VA) and U.S. Department of Defense (DoD) approved the joint Clinical Practice Guideline (CPG) for Diagnosis and Management of Low Back Pain. This CPG was intended to provide healthcare providers

some point in their lives.¹ In 2010, of all diseases and injuries contributing to disability-adjusted life years in the U.S., LBP was ranked third.²

In 2012, approximately 27.5% of adults 18 years and older

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NICE National Institute for Health and Care Excellence

NICE
guideline

CLINICAL GUIDELINES

Diagnosis and Treatment of Low Back Pain: A Joint Clinical Practice Guideline from the American College of Physicians and the American Pain Society

Roger Chou, MD; Amir Qaseem, MD, PhD, MHA; Vincenza Snow, MD; Donald Casey, MD, MPH, MBA; J. Thomas Cross Jr., MD, MPH; Paul Shekelle, MD, PhD; and Douglas K. Owens, MD, MS, for the Clinical Efficacy Assessment Subcommittee of the American College of Physicians and the American College of Physicians/American Pain Society Low Back Pain Guidelines Panel*

Recommendation 1: Clinicians should conduct a focused history and physical examination to help place patients with low back pain into 1 of 3 broad categories: nonspecific low back pain, back pain potentially associated with radiculopathy or spinal stenosis, or back pain potentially associated with another specific spinal cause. The history should include assessment of psychosocial risk factors, which predict risk for chronic disabling back pain (strong recommendation, moderate-quality evidence).

Recommendation 2: Clinicians should not routinely obtain imaging or other diagnostic tests in patients with nonspecific low back pain (strong recommendation, moderate-quality evidence).

Recommendation 3: Clinicians should perform diagnostic imaging

Recommendation 5: Clinicians should provide patients with evidence-based information on low back pain with regard to their expected course, advise patients to remain active, and provide information about effective self-care options (strong recommendation, moderate-quality evidence).

Recommendation 6: For patients with low back pain, clinicians should consider the use of medications with proven benefits in conjunction with back care information and self-care. Clinicians should assess severity of baseline pain and functional deficits, potential benefits, risks, and relative lack of long-term efficacy and safety data before initiating therapy (strong recommendation, moderate-quality evidence). For most patients, first-line medication options are acetaminophen or nonsteroidal anti-inflammatory drugs.

Low back pain and sciatica in over 16s: assessment and management

Agency for care effectiveness(ACE) Clinical Guidelines for LBP

- Workgroup members were nominated and formed by 29/10/18
- Guideline formulation were completed & presented on the 17/5/19 and rolled on Aug 2020 due to COVID-19 delay
- Members who consulted can refer to ACUIy Committee & Workgroup members slides in appendix

ACE CLINICAL GUIDANCE
Published: 1 October 2020
www.ace-his.gov.sg

When to order MRI for low back pain

Objective	Scope	Target audience
To enhance appropriate use of magnetic resonance imaging (MRI)	MRI of the lumbar spine for diagnostic investigation of low back pain	This clinical guidance is relevant to all healthcare professionals ordering MRI of the lumbar spine

Globally, low back pain leads to more years lived with disability than any other symptom or condition.¹ The prevalence of low back pain is higher among middle-aged people, as well as in high-income countries, such as Singapore.² As low back pain is largely a self-limiting condition, imaging is not indicated in most cases. When indicated, magnetic resonance imaging (MRI) of the lumbar spine is one of several imaging modalities for low back pain. However, its clinical utility varies with the clinical presentation and working diagnosis.

Statement of Intent

This ACE Clinical Guidance (ACG) provides concise, evidence-based recommendations and serves as a common starting point nationally for clinical decision-making. It is underpinned by a wide array of considerations contextualised to Singapore, based on best available evidence at the time of development. The ACG is not exhaustive of the subject matter and does not replace clinical judgement. The recommendations in the ACG are not mandatory, and the responsibility for making decisions appropriate to the circumstances of the individual patient remains at all times with the healthcare professional.

MRI for non-specific low back pain

The largest group of patients with low back pain (more than 80%) have non-specific low back pain.⁴ Typically, a diagnosis of non-specific low back pain is reached when a precise source or defined pathoanatomical cause of pain cannot be identified. For example, patient history and examination do not suggest trauma, nor features of a specific spinal pathology. Sometimes, non-specific low back pain occurs with radicular symptoms in one or both lower limbs, suggesting nerve root involvement.

Recommendation 1 Patients with non-specific low back pain, with or without radicular symptoms

MRI is not indicated

MRI is not recommended for patients with non-specific low back pain (even in the presence of radicular symptoms), particularly at initial presentation. This is because for non-specific low back pain, imaging findings tend to correlate poorly with symptoms, ultimately not altering the management decision or clinical outcomes.^{5,7} For these patients the initial management approach is usually conservative, and symptoms typically regress soon after onset. Re-assess after 4 to 6 weeks of conservative management (see Recommendation 2 below).

Recommendation 2 Patients with non-specific low back pain despite 4 to 6 weeks of conservative management

MRI may be indicated

Consider MRI when conservative management of 4 to 6 weeks has not reduced symptoms, as most patients non-specific low back pain are expected to improve after this.⁸ Lack of improvement may point to an alternate diagnosis or management approach. When present, certain factors (such as psychological distress, prolonged inactivity, or older age) may perpetuate low back pain and lead to significant disability.⁹ Therefore, reassess patient at this point to determine the need for an MRI, including the presence of aforementioned factors and likelihood of a specific spinal pathology.

Recommendation 3 Patients with low back pain and progressive neurological symptoms or signs

MRI is indicated

Progressive neurological deficits, such as deteriorating motor power or worsening numbness, may be due to a space-occupying lesion including herniation of a lumbar intervertebral disc, cancer, infection, and epidural haematoma. MRI is indicated to identify the underlying spinal pathology, especially when the progression is rapid.

Recommendation 4 Patients with low back pain and suspected cauda equina syndrome

MRI is indicated

Cauda equina syndrome is rare, but warrants urgent management. It may result from disc herniation or other spinal pathologies including cancer, infection, spinal stenosis, spondylolisthesis, and epidural haematoma. Suspect cauda equina syndrome when low back pain presents with associated features, such as bilateral lower limb symptoms or signs (like pain, motor weakness, or sensory changes), sexual dysfunction, bladder or bowel dysfunction, or saddle anaesthesia.¹⁰

Recommendation 5 Patients with low back pain and cancer or infection (suspected or known)

MRI is indicated

One should suspect cancer or infection of the spine when a patient with low back pain presents with associated features such as fever or chills, unexplained weight loss, history of cancer, immunosuppression, pain at rest or at night, intravenous drug use, or bacteraemia. MRI can localise the area and extent of disease, and hence it is indicated to investigate lumbar spinal involvement when cancer or infection is suspected.

Recommendation 6 Patients with new or progressive low back pain following an invasive procedure on the lumbar spine

MRI is indicated

Free disc fragments or scarring may result from invasive spinal procedures. For patients with new or progressive low back pain following an invasive procedure on the lumbar spine, MRI is indicated to examine potential abnormalities, for example to distinguish between scar tissue and recurrent disc herniation.

Guideline formulation
completed in 17/5/19,
rolled out in Aug 20

Formal launch
in SHS SCM on
2/12/20

Go-live in SHS
cluster on
15/12/20

- Sample screenshot of EMR order

The image displays two screenshots of an EMR order form. The top screenshot shows a dropdown menu for 'MOH ACUTY Checklist' with options like 'Suspected cauda equina syndrome or rapidly progressive neurological findings'. The bottom screenshot shows the 'MOH ACUTY Checklist' with the selected option 'Low back pain without motor deficits, less than 4-6 weeks'.

Recommended	Not recommended
<ul style="list-style-type: none"> Pain > 4-6 weeks post-conservative treatment 	<ul style="list-style-type: none"> Non-specific pain <4-6 weeks*
<ul style="list-style-type: none"> Progressive neurological symptoms or signs 	<ul style="list-style-type: none"> Patient's request*
<ul style="list-style-type: none"> Suspected or known cancer or infection 	<ul style="list-style-type: none"> Other*
<ul style="list-style-type: none"> Suspected cauda equina syndrome 	
<ul style="list-style-type: none"> New or progressive pain post invasive spine procedure 	

3 cycles of audit were done

- Manual SCM review for baseline audit
- Subsequent audits – semi automated
- Baseline (pre-ACUITY): Jan to March 2019
- Cycle 1: Dec 20 to March 21
- Cycle 2: Dec 21 to March 22

SGH Baseline case note data (Jan-Mar 2019)

492 LBP cases seen in SGH Ortho, Jan to Mar 2019 (3 months)
13% inappropriate orders

Follow-up review of order requests will be performed Jan to March 2021 to determine the change

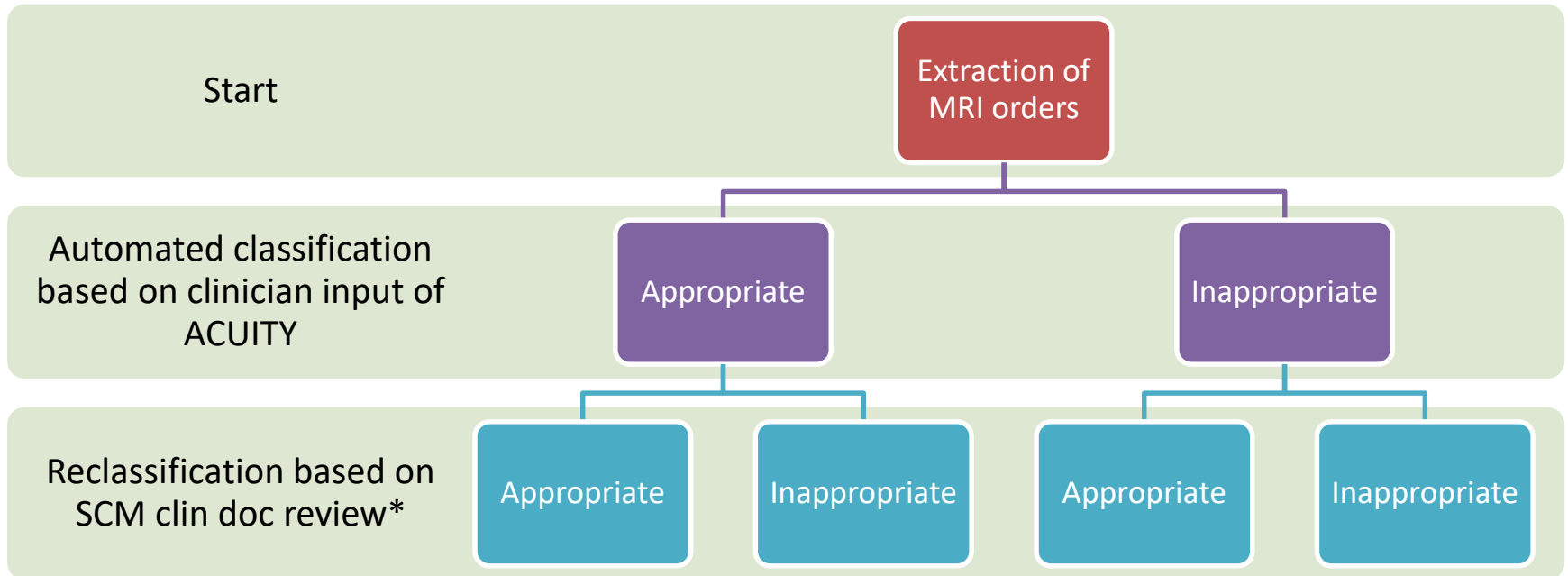
	SGH Baseline Data (Jan-Mar 2019)
Recommended guidelines	87%
Non-recommended guidelines	13%

Baseline Case Data Summary

Number of exams entered		492
Average exam value rating		7.95
Exams ordered ratings	#	%
Exams ordered rated: ≥ 7	396	80%
Exams ordered rated: 4, 5 and 6	32	7%
Exams ordered rated: ≤ 3	64	13%
Reasons recorded for why lower rating value exams were ordered	#	%
Patient Preference	32	34%
Physician Preference	63	66%
Total	95	100%

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Process (cycle 1 and 2)



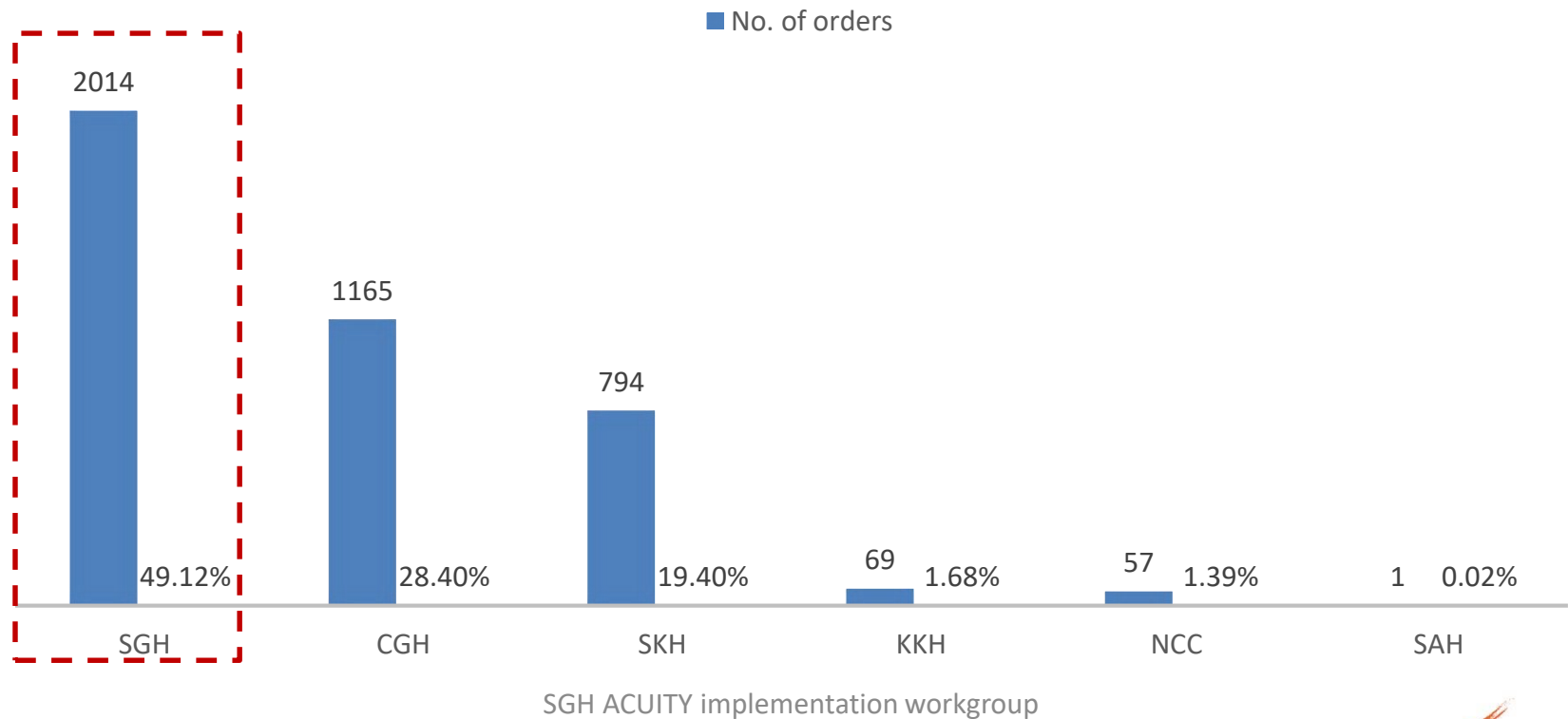
* The team also reviewed to determine if there was a discrepancy between the ACUITY input and the documented history in EMR.

Cycle 1

15 Dec 2020 to 15 Mar 2021

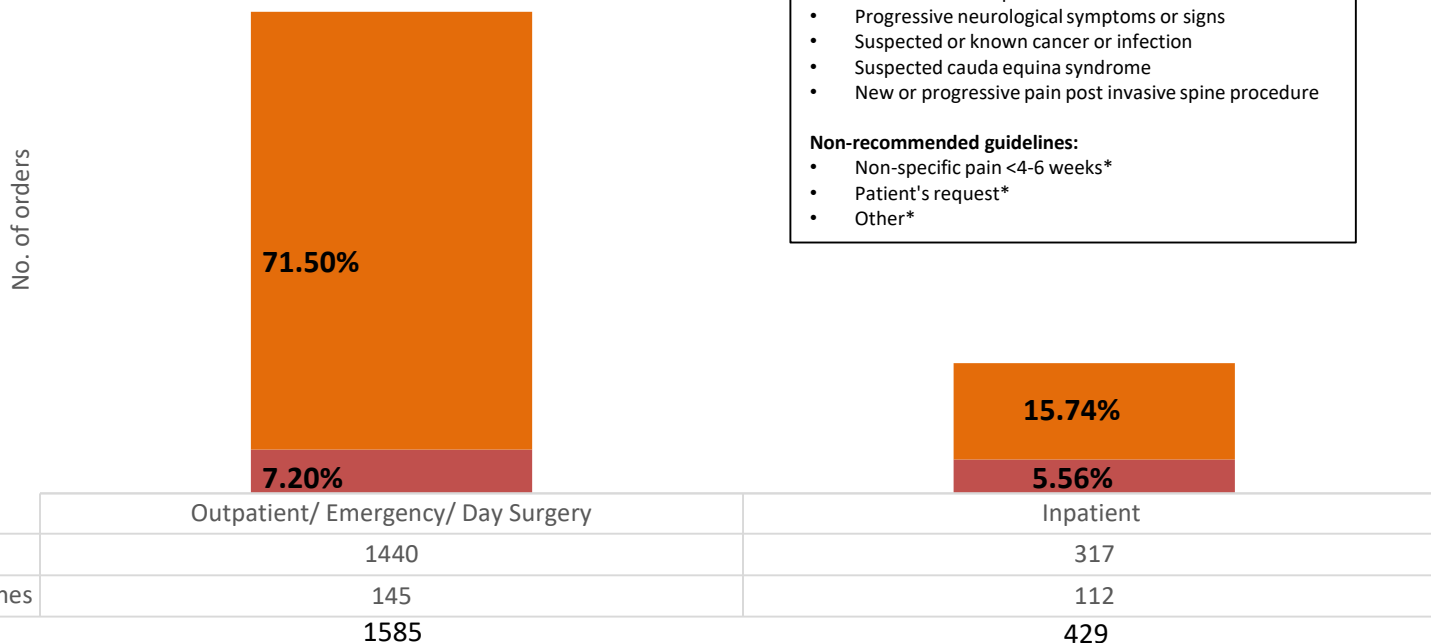
Cycle 1 - Overview of 3 months SCM data across SHS cluster (15Dec 20 -15Mar 21)

OVERVIEW OF 3 MONTH DATA ACROSS SHS CLUSTER (15DEC 20 – 15MAR 21) EXTRACTED IN APRIL 2021



>85% of MRI orders (2,014 scans) in Outpatient and Inpatients falls under the recommended guidelines

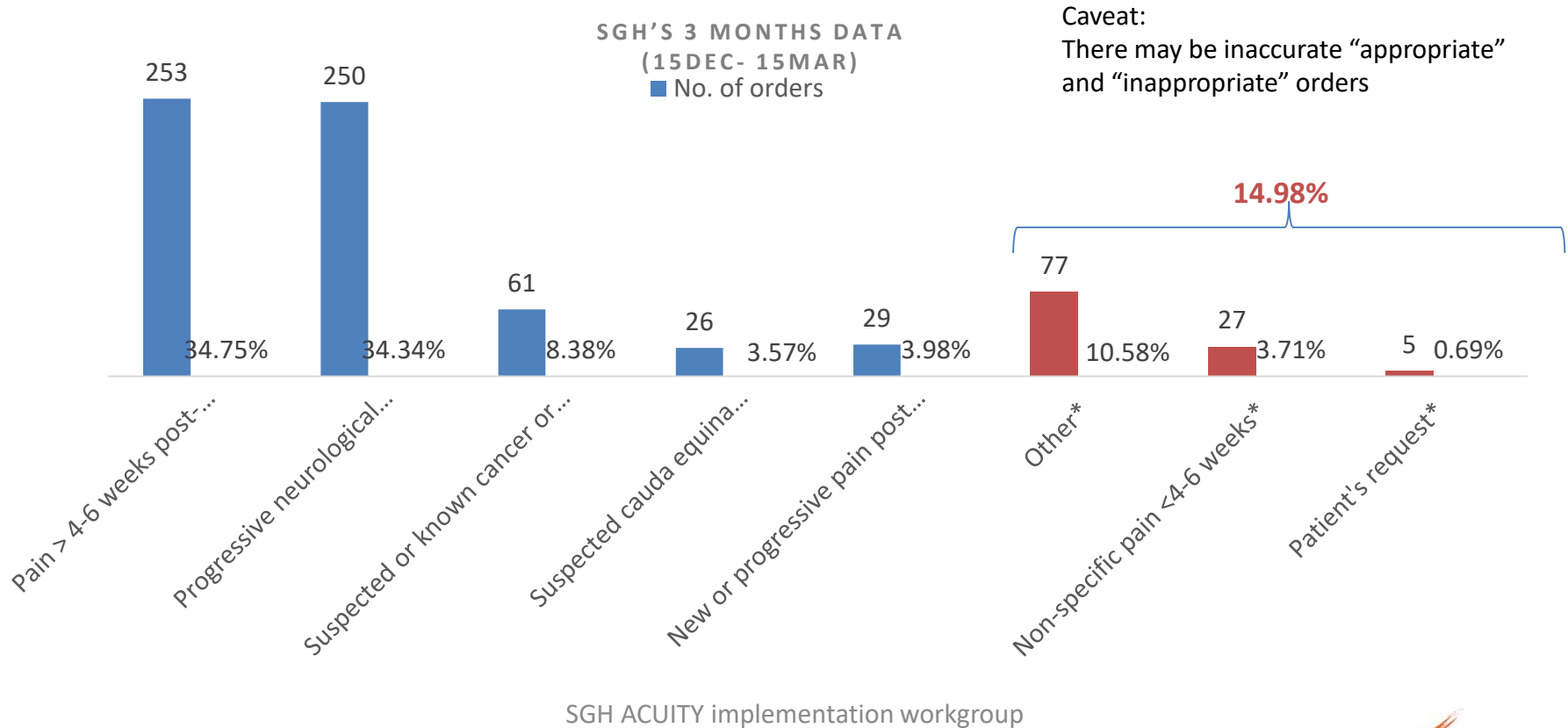
Appropriateness of outpatient vs inpatient



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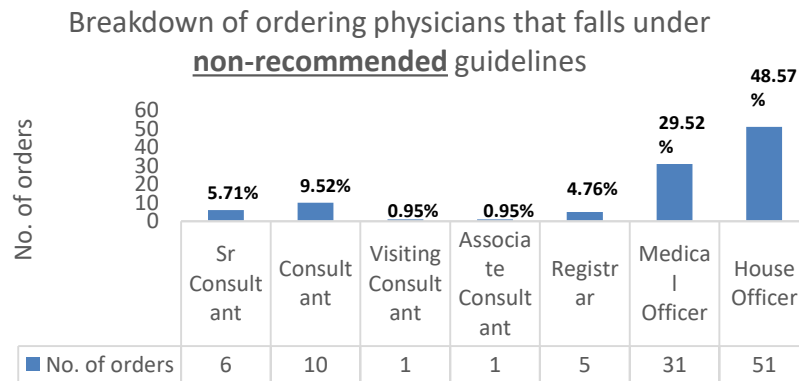
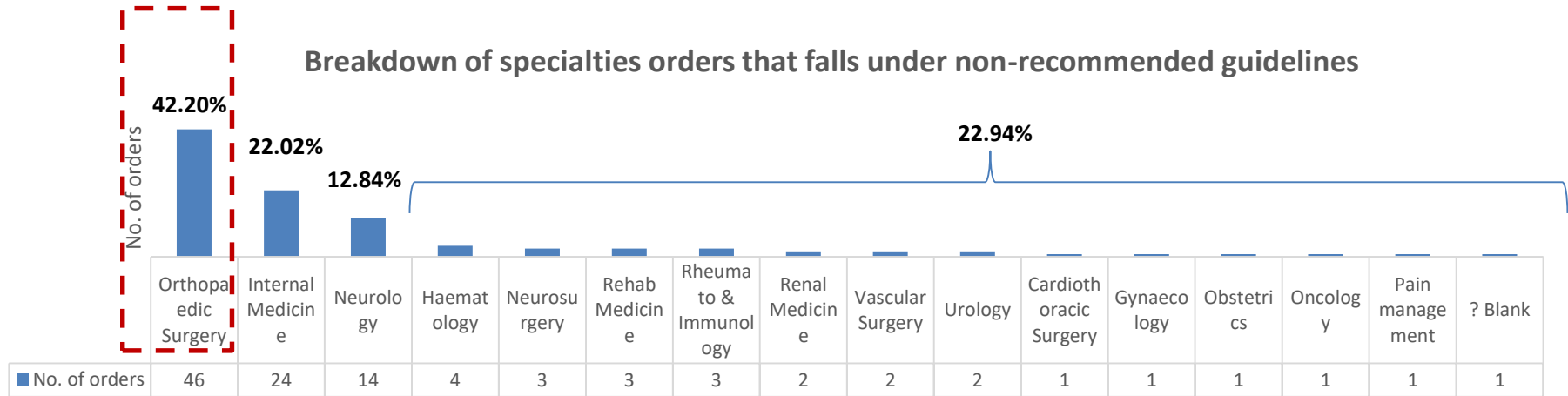
>80% falls under the recommended guidelines of SGH's performed MRI orders (15Dec 20- 15 Mar 21)

Out of 2,014 cases, 728 were performed at the time of data extraction



Orthopedics specialty makes up approximately 42% of SGH's non-recommended MRI

Inpatient	Outpatient	Emergency	Day Surgery
74	33	1	1



- House Officers orders were from inpatient
- Consultants orders were from outpatient

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Data extracted from eHints for audit

AutoSave

12 May 2022 MRI Lumbar Spine Details 15Dec21_15Mar22

Home

Insert

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Page Layout

Formulas

Data

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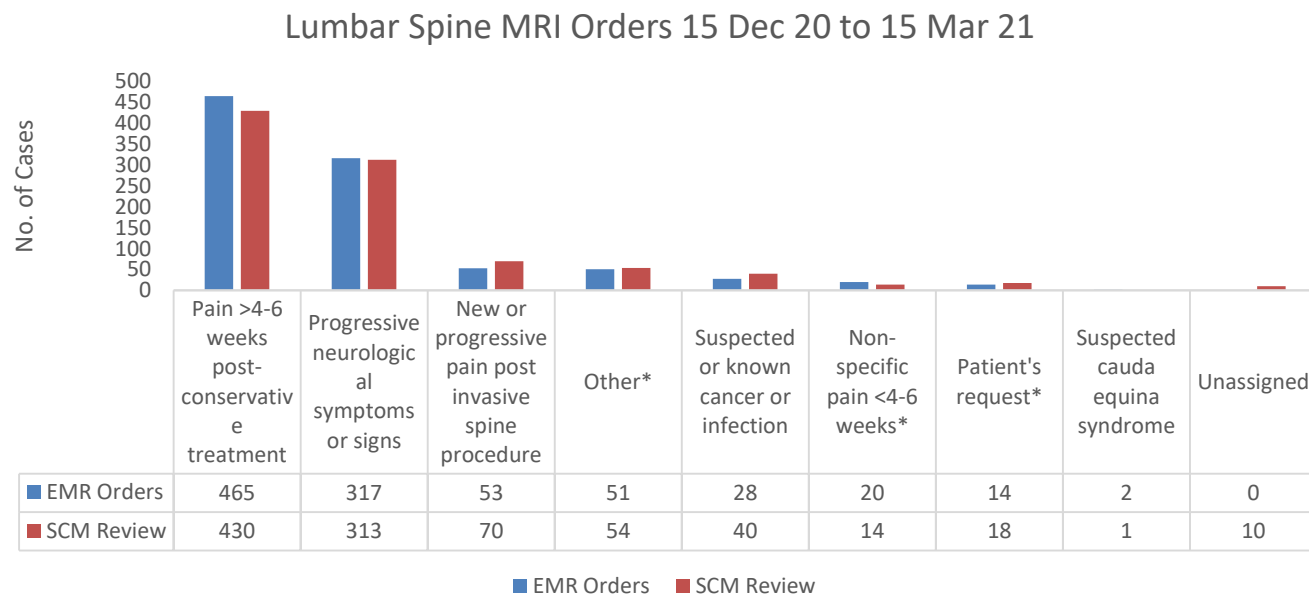
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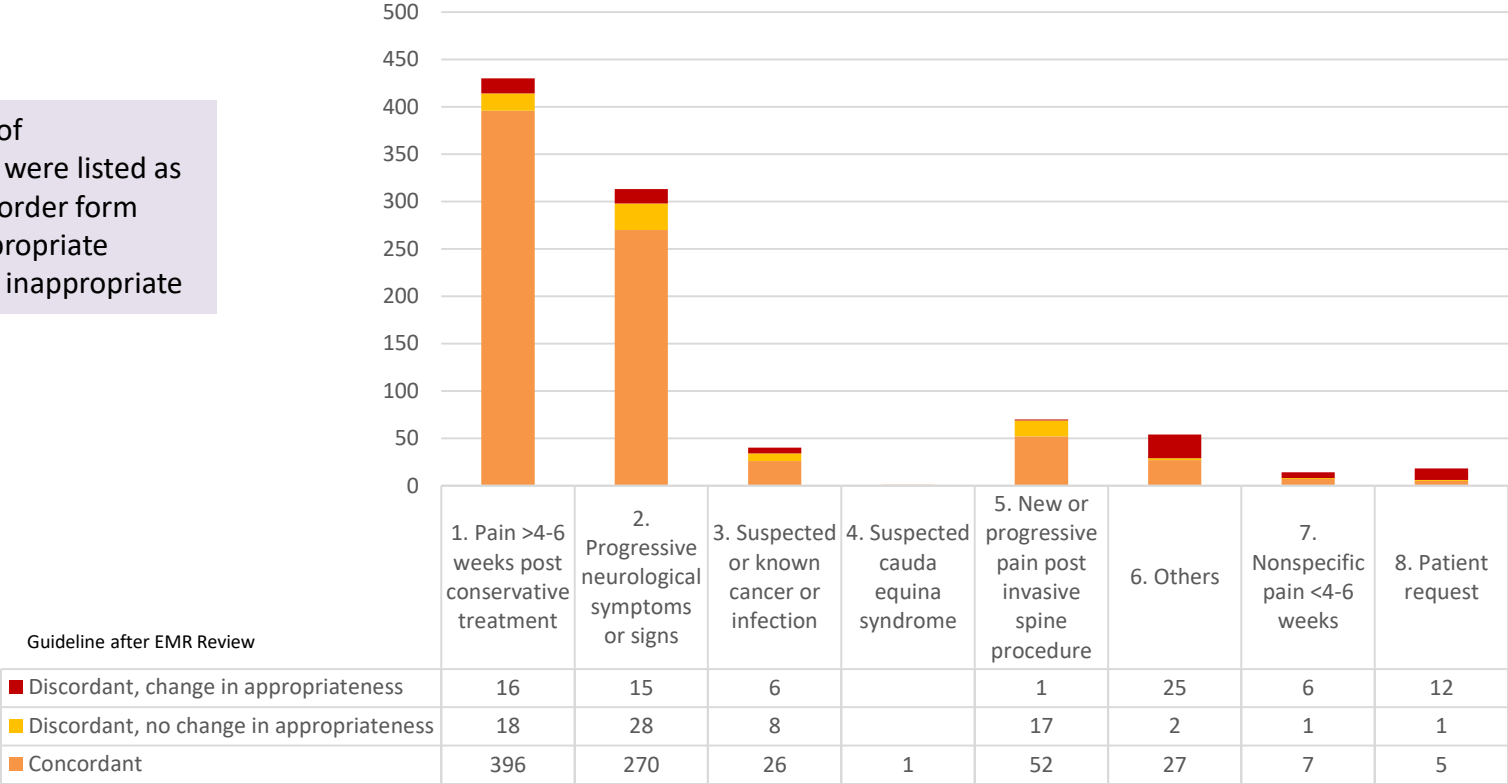
950 MRI ordered between 15 Dec 2020 to 15 Mar 2021 and performed by date of extraction (Nov 2021)

- Based on SCM data, 8.9% were inappropriate.
- Slight increase to 9.1% after EMR review



Comparing SCM data and EMR review, guideline selection for 16.4% of orders were discordant with each other

- Almost 50% (43/86) of inappropriate orders were listed as appropriate on SCM order form
- 4.4% (38/484) of appropriate orders were listed as inappropriate

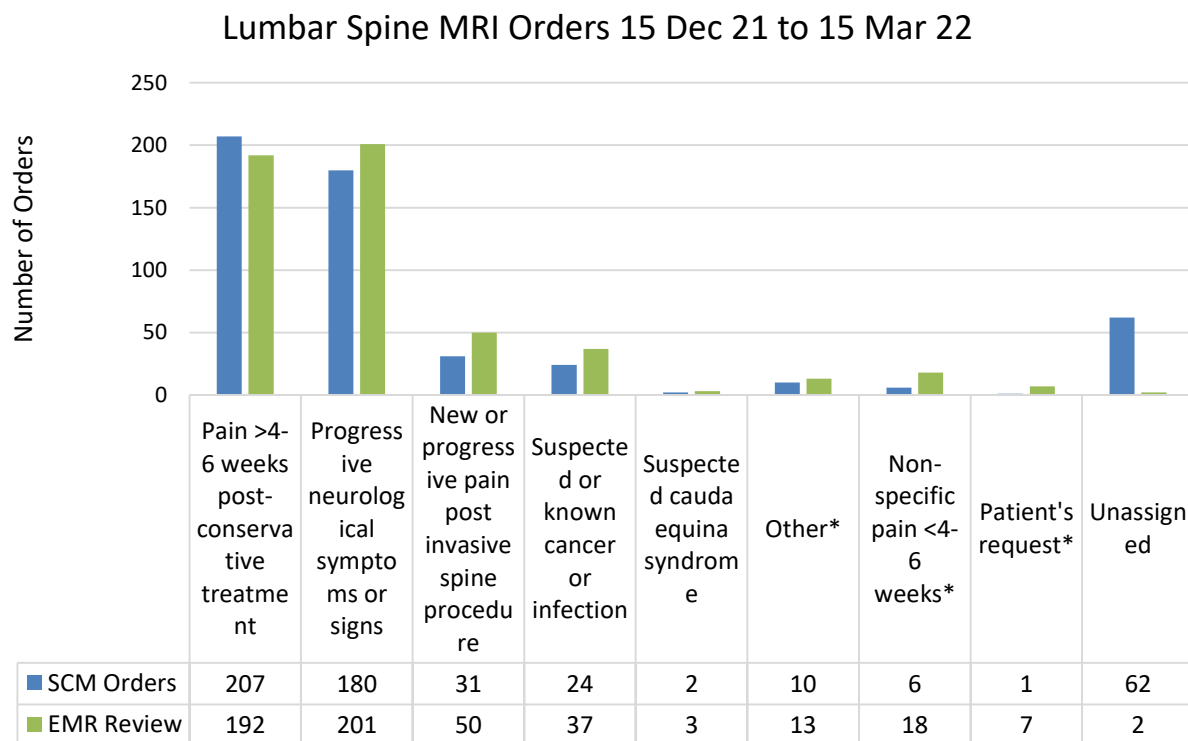


Cycle 2

15 Dec 2021 to 15 Mar 2022

523 MRI ordered between 15 Dec 2021 to 15 Mar 2022 were performed at the time of data extraction (5 May 2022).

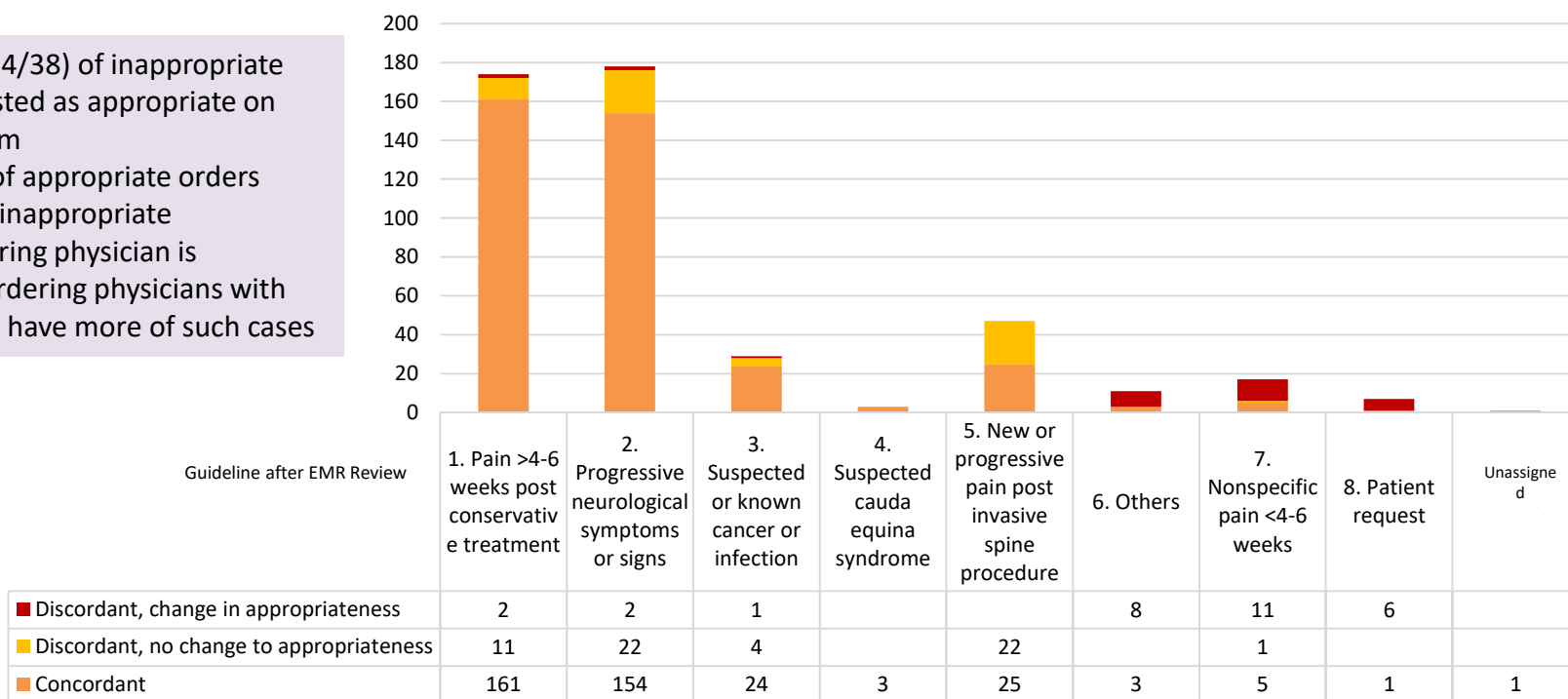
- Based on SCM data, 3.6% were inappropriate[^].
- % inappropriate **increased to 7.2% after EMR review**
- Huge difference in % inappropriate orders between SCM data and EMR review
- % inappropriate by EMR review was **better than previous reviews** done
 - 10% inappropriate by EMR review for 15 Dec 2020 to 15 Mar 2021
 - 13% before launch of SCM structured field



[^] Orders with no guidelines assigned were excluded from analysis

Comparing SCM data and EMR review, guideline selection for 17% of orders were discordant with each other

- Almost 66% (24/38) of inappropriate orders were listed as appropriate on SCM order form
- 1.5% (7/484) of appropriate orders were listed as inappropriate
- While no ordering physician is responsible, ordering physicians with higher volume have more of such cases



87.2% of orders were made by OTO. Based on EMR review, % inappropriate is lowest for orders made by MOs.

	Total No. of Orders	No. Appropriate	No. Inappropriate	% Inappropriate
AC and above*	216	201	15	6.9%
Resident	80	72	8	10.0%
MO	140	140	5	3.6%
HO	15	9	5	33.3%
OTO Overall	455	422	33	7.3%

* 1 order with no guidelines assigned was excluded from analysis

- No specific ordering physician/consultant-in-charge responsible for high number of inappropriate orders
- Any possible reasons why senior doctors have higher % inappropriate orders?
 - Inappropriate orders requires further review by senior doctors before order is made?

Currently, Doctors must give reason for order if an inappropriate guideline is selected

MOH Appropriate Care Guideline (ACG) Non-specific pain <4-6 weeks*

Reason for selection Non-specific pain

* Click here to view MOH ACG -->

Clinical Diagnosis and Reason for Exam Non-specific pain <4-6 weeks*; Non-specific pain

Compulsory field if inappropriate guideline selected

- Most inappropriate orders were due to pain ≤ 2 weeks, and also patient request
- Any other interventions to improve appropriateness of orders (e.g. surgeon education, patient education)?

- Outpatient case load in 2021 was ~6300 MRIs
- Reducing inappropriateness from 7.2% to 5.0% will reduce ~120 MRIs a year
- *Potential cost saving of \$78,000 a year (assuming 1 lumbar spine MRI is \$650)*
- *Free up 120 MRI slots a year*

	Reason	No. of Cases
Nonspecific pain <4-6 weeks	Pain ≤ 2 weeks	13
	Pain below feet	1
	Inpatient CT Lumbar Spine normal	1
	Fall, x-ray showed compression fracture	1
	To rule out radicular pain	1
Patient Request	No change/better in pain level, patient request	3
	Pain in other part (e.g. neck, lower limb), patient request	3
	Fall, x-ray showed compression fracture, patient request	1
Others	Other back issues (e.g. kyphosis, tumor surveillance, lipoma)	3
	Fall	2
	Pain unspecific duration	2
	Pain in other part (e.g. groin)	1
	Pain better, patient keen for MRI	1
	Unsteady gait	1
	No backache	1

To summarize..

	SCM Order/AcuiTy indicator	EMR Review
Baseline data (2019)	-	14.98%
15 Dec 2020-15 March 2021	8.9%	9.1%
15 Dec 2021-15 March 2022	3.6%	7.2%

What's next?

Next audit cycle planned for MRI scans ordered in 2022

Acknowledgements

- Dr Tan Cher Heng
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- Dr Ng Yeong Huei
- Imaging informatics team
- SGH office of Value driven care & clinical governance and quality

Thank you!