

Opportunities and strategies to drive appropriate use of MRI in Austria

Final report



Ludwig Boltzmann Institut

Health Technology Assessment

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List of Abbreviations

ABIM.....	American Board of Internal Medicine
AC	Appropriateness Criteria
ACCF	American College of Cardiology Foundation
ACR.....	American College of Radiology
AE.....	Adverse Event
AHA	American Heart Association
AHRQ	Agency for Healthcare Research and Quality
AOK	Allgemeine Ortskrankenkasse
AUC	Appropriate Use Criteria
AQA.....	Ambulatory Care Quality Alliance
BMG.....	Bundesministerium für Gesundheit
CADTH	Canadian Agency for Drugs and Technologies in Health
CAN	Canada
CAR.....	Canadian Association of Radiologists
CDS.....	Clinical decision support
CMA.....	Canadian Medical Association
CMS	Centers for Medicare and Medicaid Services
CRD	Centre for Reviews and Dissemination
CT.....	Computed Tomography
CTA.....	Computed tomography angiography
CTC.....	Computed tomography colonography
CPOE	Computerised physician order entry system
CW	Choosing Wisely
DICOM.....	Digital Imaging and Communications in Medicine
DRG	Diagnosis-related groups
DS.....	Decision support
EBM	Evidence Based Medicine
EC.....	European Commission
ELGA	Elektronische Gesundheitsakte
EPOC	Effective Practice and Organisation of Care
ESR	European Society of Radiology
EU	European Union
FDA.....	Food and Drug Administration
fMRI.....	functional Magnetic Resonance Imaging
GB.....	Great Britain
GP.....	General Practitioner
HTA	Health Technology Assessment
HVB.....	Hauptverband der Österreichischen Sozialversicherung
IUD	Intrauterine contraceptive devices
KAL.....	Katalog ambulanter Leistungen (catalogue of ambulatory procedures)
LR.....	Likelihood ratio
LKF	Leistungsorientierte Krankenanstaltenfinanzierung

MEL	Medizinische Einzelleistung (Individual medical procedure)
MPPR.....	Multiple procedure payment reduction policy
MRA.....	Magnetic Resonance angiography
MRI	Magnetic Resonance Imaging
MRS	Magnetic Resonance spectroscopy
MRT	Magnetic Resonance Tomography
NHS.....	National Health Service
NICE.....	National Institute for Health and Care Excellence
NMRI.....	Nuclear Magnetic Resonance Imaging
NPA	National Physicians Alliance
NSCLC	Non-small cell lung carcinoma
NSF	Nephrogenic systemic fibrosis
OECD	Organisation for Economic Co-operation and Development
OGR	Orientation Guide Radiology
PACS.....	Picture archiving and communication system
PET	Positron emission tomography
PM.....	Personalised medicine
RBM.....	Radiology benefits management
RCT.....	Randomised controlled trial
RF.....	radio frequency
SOP	Standard Operating Procedure
SVB.....	Sozialversicherungsanstalt der Bauern
UK.....	United Kingdom
USA	United States of America
VAEB	Versicherungsanstalt für Eisenbahnen und Bergbau

Summary

Background

Magnetic resonance imaging (MRI) is an essential component of medical care: it plays a vital role not only in diagnosis of diseases and injuries, but also in the monitoring of disease progression and treatment success. Currently, however, the appropriateness of diagnostic imaging is increasingly debated. In a recent publication of 26 low-value medical procedures, 12 involved medical imaging among several categories: diagnostic, preventive and preoperative testing [1]. With more than 100 MRI exams yearly per 1,000 population, Austria is leading in MRI utilisation in comparison to other OECD countries. A useful investigation is one in which the result – positive or negative – will contribute to diagnosis and will alter patient management. Inappropriate use may lead to costs without increasing diagnostic yields: not only the cost of the exams itself, but also ensuing treatment or follow-up costs, increase in waiting times and additional costs if patients are on sick leave [2]. Our aim was therefore to identify recommendations against the use of MRI and interventions to decrease inappropriate imaging relevant to the Austrian context.

die Angemessenheit von MRT wird zunehmend diskutiert

Ziel des Berichts ist die Identifikation von Empfehlungen und Interventionen, die unangemessenen MRT-Einsatz in Österreich verringern

Methods

We approached this topic from several sides. First, we screened databases for recommendations against the use of MRI in specified indications and compared to the Austrian referral guideline „Orientierungshilfe Radiologie“. Second, we performed a literature review to identify which tools and strategies are used for utilisation management of MRI and their reported effects from pilot studies and third, we conducted interviews with relevant Austrian stakeholders, in which we explored their perspectives on current and possible future measures to steer appropriate use of MRI in Austria.

3 Ansätze:

- Identifikation von Empfehlungen
- Literatursuche
- Interviews mit Stakeholdern

Results

Our screening of recommendations against the use of MRI identified several indications where recommendations differed from current referral guidelines in Austria. Current steering instruments of imaging utilisation are the centralised planning of MRI equipment, a cap on expenses, which is not coupled to performance criteria and a pre-authorisation system in which 99% of referrals are authorised. Our interviewees supported the introduction of educational measures for referrers and patients; the expansion of decision support and the facilitation of communication exchange. Current pre-authorisation is not perceived as a measure driving appropriate use.

es gibt Verbesserungspotenzial in der Steuerung der MRT-Nutzung in Österreich

Conclusion

The Austrian referral guidelines are widely accepted – we would advocate for an elaboration of these guidelines to allow referrers to better differentiate appropriate and inappropriate indications. Referrers should receive training and tools to consult patients on risks of inappropriate imaging. Radiologists should be more involved in decision making: as a minimum through consulting service lines or by integration of their expertise in alternative pre-authorisation models.

konkret werden eine Weiterentwicklung der Guideline, der Einsatz von Tools und Training für die Zuweisenden und eine stärkere Einbindung der RadiologInnen empfohlen

Zusammenfassung

Hintergrund und Problemstellung

Die Magnetresonanztomographie (MRT), ein bildgebendes Schnittbildverfahren zur Darstellung von Struktur und Funktion der Gewebe und Organe im Körper, ist ein wesentlicher Bestandteil medizinischer Versorgung: sie spielt nicht nur in der Diagnostik von Erkrankungen und Verletzungen, sondern auch im Monitoring von Krankheitsverlauf und Therapieerfolg eine entscheidende Rolle. Entstanden in den 1970er Jahren, entwickelte sich die MRT in den letzten Jahren kontinuierlich und mit zunehmender Geschwindigkeit technisch weiter. Als Konsequenz nehmen die Anwendungsgebiete der MRT laufend zu und umfassen derzeit Screening, Erstdiagnose, Follow-up und Staging sowie Monitoring. Verschiedene Spezialanwendungen wie die funktionelle MRT (fMRT), MR Angiographie (MRA) und MR Spektroskopie (MRS) bieten weitere Funktionalität und erweitern damit den Anwendungsbereich zusätzlich.

Die MRT hat im Vergleich zu anderen bildgebenden Verfahren, wie etwa der CT oder dem Röntgen, eine Reihe an Vorteilen:

- ❖ Bei der MRT wird, anders als bei der CT oder dem Röntgen, keine ionisierende Strahlung, sondern ein starkes Magnetfeld eingesetzt.
- ❖ Stoffwechselforgänge und Funktion von Geweben und Organen können, zusätzlich zur Anatomie, dargestellt werden. Durch einen höheren Weichteil-Kontrast (im Vergleich zur CT und dem Ultraschall) weist die MRT zudem eine höhere Sensitivität gegenüber Erkrankungen auf.
- ❖ Tomographische Bilder können in jeder Ebene erstellt werden, ohne dass der/die PatientIn bewegt werden muss.
- ❖ Zwei- und drei-dimensionale Bilder können produziert werden.

In der Darstellung von Knochenstrukturen (ausgenommen entzündlicher Erkrankungen oder Tumore in den Knochen), dem Respirationstrakt und der Kalkablagerung in Geweben ist die MRT der CT allerdings unterlegen. Auch die Untersuchung sich bewegender Organe (z. B. Lunge, Herz) oder von AkutpatientInnen (aufgrund von Lagerung und Dauer der Untersuchung) ist eingeschränkt.

Als mögliche Risiken und Kontraindikationen der MRT sind zu nennen:

- ❖ Die Gabe von Kontrastmitteln: Nebenwirkungen von Kontrastmitteln können in Form von Magenbeschwerden, Übelkeit und Kopfschmerz, Ausschlägen und Hautirritationen und, in sehr seltenen Fällen, als Nephrogene systemische Fibrose (NSF) auftreten. Nebenwirkungen sind jedoch generell selten.
- ❖ Verbrennungen durch falsche Lagerung.
- ❖ Implantate (Stents, Prothesen) und aktive Implantate (z. B. Herzschrittmacher), wenn sie nicht explizit gekennzeichnet sind, sind Kontraindikationen. Ferromagnetische Gegenstände (z. B. Münzen), die in das Magnetfeld geraten, stellen Risiken dar.
- ❖ Klaustrophobie und Übergewicht der PatientInnen stellen relative Kontraindikationen dar.

die MRT ist wesentlicher Bestandteil der medizinischen Versorgung

die Anwendungsgebiete nehmen laufend zu

die MRT hat eine Reihe von Vorteilen gegenüber anderen Verfahren

keine ionisierende Strahlung

hoher Weichteilkontrast

mehrdimensionale Darstellung

in einigen Indikationen ist die CT überlegen

Kontraindikationen und Risiken der MRT sind Kontrastmittel

**Verbrennungen
Implantate und ferromagnetische Gegenstände**

Klaustrophobie und Übergewicht

**2013 waren in Österreich
153 MRT-Geräte im
Einsatz

die MRT-
Untersuchungen stiegen
zwischen 2009 und 2012
um 3,3 % an**

**in Österreich werden
überdurchschnittlich
viele MRTs
durchgeführt**

**die Angemessenheit
bildgebender Verfahren
wird diskutiert**

**unangemessene
Untersuchungen haben
unterschiedlichste
negative Konsequenzen**

**der in der Literatur
beschriebene Anteil
unangemessener
Verfahren variiert stark**

In Österreich waren im Jahr 2013 insgesamt 153 MRT-Geräte im Einsatz, Österreich liegt mit dieser Gerätezahl über dem OECD Durchschnitt (18,7 Geräte pro 1 Million EinwohnerInnen). Unabhängig vom Setting stiegen in Österreich die Gesamtzahlen an MRT-Untersuchungen zwischen 2009 und 2012 um 3,3 % an, weniger als die Hälfte der Untersuchungen wurden in Spitälern erbracht. Mit mehr als 100 jährlichen MRT-Untersuchungen pro 1.000 EinwohnerInnen führt Österreich die Statistik der OECD Länder deutlich an, was auf einen möglicherweise übermäßigen und unangemessenen Einsatz der Technologie hindeutet. Diese Zahl bezieht sich auf Untersuchungszahlen pro PatientIn pro Tag, wobei eine unbekannte Zahl der Untersuchungen mit dem Faktor 1,9 multipliziert wird. Mehr als ein Drittel der stationär erbrachten MRTs waren 2012 Kopf- und Hals-Untersuchungen, am zweithäufigsten wurde die Wirbelsäule untersucht. Im Jahr 2012 wurden 243,9 Millionen Euro für bildgebende Diagnostik ausgegeben, was rund 0,8 % der gesamten Gesundheitsausgaben ausmacht.

Derzeit wird die Angemessenheit bildgebender Verfahren in Diagnostik und Screening zunehmend diskutiert. Eine angemessene Untersuchung führt zu einer Diagnose und einer Veränderung der Therapie(planung). Unangemessene und/oder übermäßige Verwendung kann dagegen zu Kosten führen, ohne dass klinische Ergebnisse erzielt werden: nicht nur Kosten, die direkt mit der Untersuchung zusammenhängen, sondern auch Folgekosten, die durch Therapie und Follow-up entstehen, durch steigende Wartezeiten und vermehrte Krankenstandstage. Zudem können für die/den PatientIn negative Konsequenzen wie unnötige Tests und Behandlungen, Stigmatisierung und Angst entstehen.

Das in der internationalen Literatur beschriebene Ausmaß an unangemessenen Untersuchungen durch bildgebende Verfahren variiert stark und hängt von verschiedenen Faktoren ab: der Untersuchungsmethode, bestimmten Indikationen, der zuweisenden medizinischen Fachrichtung, dem Setting (intra- oder extramural) sowie von den Kriterien, durch die Angemessenheit bestimmt wird.

Ziel und Forschungsfragen

Ziel des vorliegenden Berichts ist die Identifikation von Strategien und Maßnahmen, um den unangemessenen Einsatz der MRT in Österreich zu reduzieren. Zudem werden explizite Empfehlungen gegen den Einsatz der MRT für bestimmte Indikationen identifiziert.

Forschungsfragen:
- Definitionen für Angemessenheit/ Unangemessenheit
- Empfehlungen gegen den Einsatz von MRT
- Steuerungsinstrumente zur Reduktion unangemessener Anwendung
- derzeitige Anwendung und Kontrolle der MRT in Österreich

Folgende Forschungsfragen wurden untersucht:

1. Welche Kriterien definieren Angemessenheit bzw. Unangemessenheit von MRT in Diagnostik und Screening?
2. Welche expliziten Empfehlungen gegen den Einsatz von MRT unter bestimmten Voraussetzungen und für bestimmte Indikationen gibt es?
3. Welche Instrumente und Steuerungsmechanismen werden zur Bewältigung der unangemessenen Anwendung der MRT empfohlen? Gibt es wissenschaftliche Nachweise für die Effektivität dieser Instrumente und Mechanismen?
4. Wie wird die MRT derzeit in Österreich genutzt: welche Kriterien und Mechanismen werden eingesetzt, um den Einsatz existierender MRT-Geräte zu steuern?

Methoden

Im vorliegenden Bericht wurden drei Methoden-Ansätze verfolgt. Zunächst wurden öffentlich verfügbare internationale Empfehlungen gegen den Einsatz der MRT für bestimmte Indikationen analysiert und mit der österreichischen „Orientierungshilfe Radiologie“ verglichen. Eine Literatursuche wurde durchgeführt, um Strategien und Instrumente zu identifizieren, die für das Nutzenmanagement („utilisation management“) von MRT eingesetzt werden. Gleichzeitig wurden dokumentierte Erfolge im Rahmen von Pilotprojekten identifiziert. Anschließend wurden Interviews mit österreichischen Stakeholdern geführt, in welchen deren Meinung zu derzeitigen und möglichen zukünftigen Steuerungsmaßnahmen für einen angemessenen Einsatz der MRT im österreichischen Kontext erfragt wurde.

3 Ansätze:

- Identifikation von Empfehlungen
- Literatursuche
- Interviews mit Stakeholdern

Ergebnisse

Definition von Angemessenheit und Unangemessenheit der MRT

Generell wird die Angemessenheit eines Tests oder einer Behandlung definiert durch Nutzen, Risiko, vorhandene Ressourcen und individuelle Charakteristika von PatientInnen. Grundsätzlich gilt eine Untersuchung als angemessen, wenn der erwartete Gesundheitsnutzen die zu erwartenden negativen Folgen übersteigt.

die Angemessenheit einer Behandlung oder eines Tests wird definiert durch Nutzen, Risiko, vorhandene Ressourcen und individuelle Charakteristika von PatientInnen

Der unangemessene Gebrauch von Gesundheitstechnologien kann unterschiedliche Ausprägungen und Ursachen haben und beinhaltet sowohl deren falschen als auch übermäßigen Gebrauch. Einige der Hauptgründe für unangemessenen Einsatz sind:

- ✧ unnötige Wiederholung von Untersuchungen
- ✧ Untersuchungen die nicht zu einer Änderung im PatientInnenmanagement führen
- ✧ zu häufige Untersuchungen
- ✧ falsche Untersuchungen
- ✧ fehlende klinische Information und das Fehlen von relevanten Fragestellungen
- ✧ übermäßige Untersuchung („over-investigation“)

Unangemessenheit kann verschiedene Ursachen haben

Ein anderer Aspekt, der im Zusammenhang mit der MRT und anderen bildgebenden Verfahren diskutiert wird, ist „Overdiagnosis“. Diese tritt auf, wenn bei asymptomatischen Personen eine Erkrankung diagnostiziert wird, die bei ihnen weder zu Symptomen noch zu einem frühzeitigen Tod führen wird. Eigentlich gesunde Personen werden demnach als krank klassifiziert. Folgen können neben unnötigen Tests und Behandlungen auch Angst und Stigmatisierung sowie die Verschwendung limitierter Ressourcen sein. Zugrunde liegende Ursachen sind technologischer Fortschritt, kulturelle Normen, kommerzielle Interessen, gesetzliche Anreize und erweiterte Krankheitsdefinitionen.

eigentlich gesunde Personen werden als krank klassifiziert

zugrunde liegende Faktoren und Konsequenzen sind komplex

Empfehlungen gegen den Einsatz der MRT

Immer mehr internationale Programme und Initiativen entstehen, die den unangemessenen Einsatz von Gesundheitstechnologien eindämmen wollen, indem konkrete Empfehlungen formuliert werden, die sich sowohl an ÄrztInnen und andere Gesundheitsberufe als auch an PatientInnen/KonsumentInnen richten.

Zahl an internationalen Empfehlungen steigt

sechs analysierte Programme/Initiativen

Im vorliegenden Bericht wurden die Empfehlungen sechs internationaler, öffentlich zugänglicher Programme analysiert:

- ✦ Choosing Wisely® Kampagne (USA)
- ✦ Choosing Wisely Canada Kampagne (Kanada)
- ✦ NICE ‘Do not do’ Datenbank und NICE ‘referral advice’ Datenbank (Vereinigtes Königreich)
- ✦ Appropriateness Criteria® des College of Radiology (USA)
- ✦ CAR Referral Guidelines (Kanada)
- ✦ ACCF Appropriate Use Criteria (USA)

insgesamt 253 Empfehlungen gegen den Einsatz der MRT

Insgesamt wurden 253 Empfehlungen identifiziert, von denen ein Großteil von den Appropriateness Criteria® des College of Radiology stammt. Die Empfehlungen wurden nach betroffenem Körperteil klassifiziert und anhand unterschiedlicher Charakteristika analysiert (siehe Kapitel 4.2).

Folgende Erkenntnisse wurden erzielt:

21 % gegen Kopf-MRT

- ✦ Die meisten Empfehlungen gegen den Einsatz der MRT (21 %) beziehen sich auf Kopf- Untersuchungen (inkl. Schädel und Gehirn).

69 % gegen MRT zur Erstdiagnose

- ✦ 69 % der Empfehlungen raten von einem Einsatz der MRT als Methode zur Erstdiagnose ab (z. B. vor einer Ultraschall- oder Röntgenuntersuchung).

27 % bezogen auf Onkologie

- ✦ Das Fachgebiet, auf das sich der Großteil (27 %) der Empfehlungen bezieht, ist die Onkologie.

nur wenige Überschneidungen zwischen den Programmen

- ✦ Aufgrund von Unterschieden in der Anzahl an Empfehlungen und der unterschiedlich detaillierten Beschreibung der Krankheitsbilder, ist die Anzahl an programm-übergreifenden Empfehlungen gering. Die umfassendste Übereinstimmung, auch mit der Orientierungshilfe Radiologie, gab es für die Diagnose von unkomplizierten Rückenschmerzen (keine MRT ohne „Red Flags“).

internationale Empfehlungen und die Orientierungshilfe Radiologie stimmen zum Großteil überein

- ✦ Wo ein direkter Vergleich möglich war, stimmten die internationalen Empfehlungen gegen den Einsatz der MRT zum Großteil mit jenen der Orientierungshilfe überein. Gründe für differierende Empfehlungen (13 Abweichungen wurden identifiziert) sind möglicherweise Ziele und Methoden der Empfehlungsentwicklung, widersprüchliche Evidenz, variierende Kriterien und das Detailniveau der Beschreibung von Krankheitsbildern und Interventionen. Die Orientierungshilfe beinhaltet eine wesentlich gröbere und weniger differenzierte Klassifikation und Beschreibung (z. B. in Bezug auf die Verwendung von Kontrastmitteln) der verschiedenen Krankheitsbilder und Interventionen als viele der internationalen Empfehlungen. Zudem sind nicht alle Situationen, die von den Empfehlungen beschrieben werden, in der Orientierungshilfe enthalten. Insgesamt wurde für rund 60 analysierte Empfehlungen eine direkte Entsprechung in der Orientierungshilfe identifiziert.

direkte Vergleiche sind jedoch schwierig

Interventionen gegen den unangemessenen Einsatz bildgebender Verfahren

unvollständige Umsetzung von Guidelines als Ursache

Evidenzbasierte Guidelines definieren die Angemessenheit von bildgebenden Verfahren für bestimmte Krankheitsbilder. Unterschiedliche Faktoren – sowohl auf Seiten der ÄrztInnen als auch der PatientInnen – können der Umsetzung dieser Guidelines im Weg stehen und somit den unangemessenen Einsatz bildgebender Verfahren befördern.

Interventionen gegen den unangemessenen Einsatz bildgebender Verfahren wurden durch eine Literatursuche identifiziert und durch die Erkenntnisse aus den Stakeholder-Interviews ergänzt. Viele unterschiedliche Interventionen können eingesetzt werden, um den angemessenen Einsatz bildgebender Verfahren zu steigern. Nach der Taxonomie der Cochrane Effective Practice and Organisation of Care (EPOC)-Arbeitsgruppe, können solche Interventionen in vier Kategorien eingeteilt werden, wobei jeweils unterschieden wird, ob ÄrztInnen oder PatientInnen Ziel der Intervention sind:

Literatursuche und Stakeholder-Interviews zu Interventionen

kategorisiert nach EPOC-Taxonomie

Bildungsmaßnahmen

- ❖ Entwicklung und Verbreitung von Richtlinien für die ZuweiserInnen, basierend auf Evidenz und Konsensprozessen.
- ❖ Entwicklung von „Decision support tools“ (Entscheidungshilfen) wie diagnostischen Pfaden, klinischen Entscheidungsregeln und eventuell elektronischen Entscheidungshilfen.
- ❖ Verbreitung von Spitalsdaten zum Einsatz bildgebender Verfahren, gemeinsam mit Guidelines, um die öffentliche Wahrnehmung von übermäßigem Gebrauch zu steigern.
- ❖ Training mit fingierten PatientInnen, um ZuweiserInnen Übung zu geben, den wachsenden Forderungen der PatientInnen gegenüber zu treten.

4 identifizierte Bildungsmaßnahmen

Training und Entscheidungshilfen sind von Bedeutung

Regulatorische und finanzielle Maßnahmen

- ❖ „Pay-for-performance“-Modelle, basierend auf robusten Messgrößen und Instrumenten für Leistungserbringung.
- ❖ Gedeckelte Bezahlungsmodelle mit fixen Zahlungen pro PatientIn, unabhängig von der Anzahl an Behandlungen.
- ❖ Zusatzzahlungen der PatientInnen.
- ❖ Zulassung von AnbieterInnen bildgebender Verfahren, um Selbstzuweisungen zu limitieren.
- ❖ Streichung von nachgewiesen ineffektiven Leistungen aus dem Leistungskatalog.
- ❖ Formelle Bewilligung geplanter Technologien/Verfahren durch die Versicherungen.

6 regulatorische und finanzielle Maßnahmen identifiziert

„Pay-for-performance“-Modelle werden empfohlen

Organisatorische und strukturelle Maßnahmen

- ❖ Revidierung der Berufsrollen: „Gatekeeper“-Funktion der praktischen ÄrztInnen, sowie ExpertInnen- und BeraterInnenrolle der RadiologInnen.
- ❖ Schaffung multi-disziplinärer Teams, um die Expertise von ZuweiserIn und RadiologIn zu kombinieren und den Einsatz bildgebender Verfahren in Spitalern zu koordinieren.
- ❖ „Point-of-care“-Beteiligung der RadiologInnen durch Telefonberatung (Hotlines) oder „radiology benefits manager“ (externe BeraterInnen).
- ❖ Standardisierte digitale Zuweisungen, um die Vollständigkeit der Zuweisungsinformation zu gewährleisten, eventuell gemeinsam mit elektronischem „Decision support“.
- ❖ Qualitätssteigerung durch Monitoring der Nutzung bildgebender Verfahren, gemeinsam mit entweder öffentlicher Berichterstattung oder mit zielgerichteten Ausbildungsbesuchen bei ZuweiserInnen mit ungewöhnlichen Zuweisungsmustern.

5 organisatorische und strukturelle Maßnahmen

multi-disziplinäre Teams, Einbindung von RadiologInnen standardisierte, digitale Zuweisungen und Monitoring

einige Pilotprojekte zeigen den Erfolg der Maßnahmen

In einigen ausgewählten Projekten konnten durch Bildungsmaßnahmen, Entscheidungshilfen („Decision support tools“) oder fixe Zahlungsmodelle nachweislich Erfolge in der Reduktion unangemessener Untersuchungen mit bildgebenden Verfahren erzielt werden. Generell ist die Erfolgsaussicht auf eine Veränderung der derzeit herrschenden Kultur größer, wenn mehrere Maßnahmen als „Paket“ eingesetzt werden.

Folgende Erkenntnisse wurden aus der Befragung österreichischer Stakeholder gewonnen:

die Befragung der Stakeholder zeigte Bedarf an Fortbildung, Entscheidungshilfen sind nicht standardisiert, Forderungen von PatientInnen sind relevant

- ✦ Derzeitige Arbeitsabläufe erlauben keine Einbindung der Expertise der RadiologInnen in den Entscheidungsfindungsprozess.
- ✦ Es gibt einen Bedarf an Fortbildung und Training für ZuweiserInnen zum Thema angemessener Einsatz bildgebender Verfahren.
- ✦ Derzeitige Entscheidungshilfen bestehen hauptsächlich aus der Österreichischen „Orientierungshilfe Radiologie“ und gelegentlichem, unregelmäßigem Austausch zwischen RadiologInnen und ZuweiserInnen.
- ✦ Forderungen von PatientInnen werden als Ursache für unangemessenen Gebrauch bildgebender Verfahren angesehen.
- ✦ Standardisierter Informationsaustausch könnte zu einem verbesserten Nutzungsmanagement beitragen.
- ✦ Externes Monitoring/“pay for performance“ ist im derzeitigen Kosten-erstattungs-Modell schwierig zu implementieren.
- ✦ Die derzeitige Form der Vorab-Autorisierung durch den cheförztlichen Dienst ist unzureichend, um den unangemessenen Einsatz bildgebender Verfahren zu reduzieren.

externes Monitoring schwer zu implementieren

derzeitige Vorab-Autorisierung unzureichend

Schlussfolgerung und Empfehlungen

strenge Auswahl der PatientInnen durch ZuweiserInnen nötig

Der Großteil der identifizierten Empfehlungen gegen den Einsatz der MRT beziehen sich auf MRT als Methode zur Erstdiagnose: das lässt darauf schließen, dass es von besonderer Bedeutung ist, PatientInnen, basierend auf gründlicher klinischer Untersuchung, streng auszuwählen, bevor sie zu einer MRT überwiesen werden. Sowohl die Literaturübersicht als auch die Interviews zeigen, dass die Bestimmung der Angemessenheit bildgebender Verfahren komplex ist und Training, Expertise und Erfahrung verlangt, welches ZuweiserInnen oder jungen SpitalsärztInnen oftmals fehlt. Zusammen mit einer Praxis der Defensivmedizin und steigenden PatientInnenforderungen kann das wesentlich zu einem übermäßigen Gebrauch bildgebender Diagnostik beitragen. Die Interviews machen deutlich, dass die Orientierungshilfe Radiologie einen hohen Bekanntheitsgrad und eine große Akzeptanz in Österreich erreicht hat, während andere Programme und Initiativen entweder unbekannt sind oder als Grundlage von (negativen) Entscheidungen nicht akzeptiert werden. Es scheint daher ratsam, die breite Akzeptanz der Orientierungshilfe zu nutzen und detaillierte Empfehlungen, auch gegen den Einsatz der MRT, in die Guideline aufzunehmen.

Training, Expertise und Erfahrung fehlen oftmals

Orientierungshilfe Radiologie ist bekannt und akzeptiert

ausgewählte Indikationen für Maßnahmen

Aufgrund der großen Zahl an MRT-Indikationen wäre es sinnvoll, Managementmaßnahmen auf ausgewählte Indikationen zu konzentrieren, anstatt global Entscheidungshilfen einzusetzen. Die Auswahl dieser Ziel-Indikationen sollte auf nachgewiesenen hohen Zahlen zum unangemessenen Nutzen, häufigem Einsatz und hohen Kosten basieren.

Detailliertere Guidelines für ZuweiserInnen, die diese dazu ermutigen, differenzierte Entscheidungen zur Angemessenheit von bildgebenden Verfahren zu treffen, sind ein wichtiges Element zur Steigerung der Angemessenheit. Die Ergebnisse der Literaturübersicht weisen jedoch darauf hin, dass Guidelines durch Bildungsmaßnahmen für ZuweiserInnen und PatientInnen ergänzt werden sollten. Die identifizierten Maßnahmen sind Entscheidungshilfen für ZuweiserInnen, Training für den Dialog mit PatientInnen und öffentliches Bewusstsein zu übermäßigem Gebrauch und verfügbaren Guidelines. Diese Ergebnisse decken sich auch mit den Ansichten der Österreichischen Stakeholder, die ebenso einen Bedarf an Fortbildung und Training für ZuweiserInnen sehen.

**detailliertere
Guidelines nötig**

**ergänzt durch
Bildungsmaßnahmen**

**Fortbildung und
Training entscheidend**

Wir empfehlen:

- ❖ prospektive Studien zur Nutzung und Angemessenheit der MRT, unter Verwendung vorab spezifizierter Kriterien für Angemessenheit in ausgewählten Indikationen,
- ❖ die Auswahl von Verfahren, basierend auf Daten zu hoher regionaler Variabilität in der MRT-Nutzung und basierend auf Indikationen, welche häufig durchgeführt werden und hohe Kosten verursachen, für die die Einführung von Maßnahmen gerechtfertigt wäre,
- ❖ das Pilotieren dieser Interventionen in „motivierten“ Spitälern sowie Monitoring, Evaluierung und Publikation der Ergebnisse,

prospektive Studien

**Auswahl einiger
high volume
Indikationen**

**Pilotprojekte zu
ausgewählten
Maßnahmen**

Ergänzt durch:

- ❖ einen Konsensusprozess zu Angemessenheitskriterien und die Adaption der „Orientierungshilfe Radiologie“ für ausgewählte Indikationen, basierend auf Gebieten mit fehlendem Konsensus zwischen der Orientierungshilfe und den internationalen Empfehlungen,
- ❖ Entscheidungshilfen für ZuweiserInnen und PatientInnen und
- ❖ öffentlicher Bewusstseinsbildung zu Overdiagnosis und übermäßigem Einsatz bildgebender Diagnostik.

**Adaptierung der
Orientierungshilfe
Radiologie**

**Entscheidungshilfe für
ZuweiserInnen und
PatientInnen**

1 Introduction

Magnetic resonance imaging (MRI) is a tomographic imaging technique used to investigate the morphology and function of tissue and organs of the human body. Emerging in the 1970ies, MRI (also referred to as nuclear magnetic resonance imaging [NMRI] or magnetic resonance tomography [MRT]) is technically advancing ever more rapidly, and is increasingly applied for a wide range of indications [3]. Faster imaging techniques allow a reduction of time needed to acquire image data [3, 4].

Currently, however, the appropriateness of diagnostic imaging is increasingly debated. In a recent publication on 26 low-value medical procedures, 12 involved medical imaging among several categories: diagnostic, preventive and preoperative testing [1].

Estimates of inappropriate imaging are reported to amount to up to 30%, or even up to 77% inappropriate use for certain applications [5]. The proportion of inappropriate imaging is however very variable and depends on different factors such as the imaging technique, specific indications, the medical specialty requesting the orders, inpatient vs. outpatient setting, and the appropriateness criteria used. In the following we aim to present this variability of estimates.

Using the RAND¹ methodology of generating appropriateness scores for medical tests and procedures [6], Emery *et al.* prospectively defined appropriateness of MRI outpatient requests and matched them to 2,000 outpatient requisitions (1,000 for lumbar spine MRI and 1,000 for head MRI for headache). This Canadian study found 28.5% of lumbar spine MRI requests inappropriate, and an additional 27.2% of uncertain value; inappropriateness of lumbar spine MRI was high across most indications [7]. In contrast, most MRI scans for headache (82.2%) were found appropriate in this study. An analysis of computer tomography (CT) and MRI requests across indications in British Columbia (Canada) using a five-point rating scale for appropriateness based on Canadian Association of Radiologists (CAR) guidelines and a meta-analysis of other guidelines found the rates of inappropriate imaging accounting to only 2% [8]. A survey of inappropriate use of MRI in a Finnish University Hospital using the European Commission (EC) referral guidelines, found 7% inappropriate examinations [9]. An Italian study on outpatient requests found 22% of requested radiological examinations not indicated according to Italian national guidelines [10]. In an analysis of outpatient referrals for CT and MRI using on evidence-based appropriateness criteria from a radiology benefit management company 35% of referrals for MRI of the spine and 37% for MRI of the shoulder were considered inappropriate [11].

Analyses of imaging use for staging of low-risk prostate cancer based on hospital [12] or SEER²-Medicare [13] databases revealed a significant overuse of pre-operative imaging, despite the non-recommendation according to current guidelines. Choi *et al.* also identified significant geographic variation in imaging use [13].

die MRT stellt Morphologie und Funktion von Körpergewebe und Organen dar

die Angemessenheit von MRT wird diskutiert

in bestimmten Anwendungsbereichen gibt es bis zu 77 % unangemessene bildgebende Untersuchungen

eine kanadische Studie identifizierte 28,5 % unangemessene MRT-Anordnungen der Lendenwirbelsäule

82,2 % der MRT-Untersuchungen bei Kopfweh waren dagegen angemessen

andere Studien berichten von nur 2 % bis 37 % unangemessenen Untersuchungen

zu häufiger MRT-Gebrauch besteht beim Staging von risikoarmem Prostatakarzinom,

¹ Named after the RAND corporation, that developed them.

² Surveillance, epidemiology and end results

<p>beim Schulter-MRT und bei frühzeitigen Fuß- und Knöchel- Untersuchungen</p>	<p>A different approach quantifies rates of overutilization by comparing the number of scans ordered following a thorough evaluation of clinical history, previous imaging and physical examination by a specialist to the numbers of MRI carried out if MRI is used routinely for pre-evaluation screening. For shoulder MRI, this led to an estimate of 90% over-utilisation [14]. Another study analysed foot or ankle scans performed prior referral to a foot and ankle specialist and found 87% of pre-referral scans unnecessary [15].</p>
<p>Anstieg von MRT-Untersuchungen in Österreich</p> <p>Österreich weltweit führend im Bereich Untersuchungen/ EinwohnerIn</p>	<p>Total numbers of MRI examinations in Austria increased from 974,818 to 1,006,673 between 2009 and 2012 (Table 2.3-2). With these numbers, Austria is amongst the OECD countries with the highest numbers of examinations per 1,000 population (Figure 2.3-6), indicating potential over-utilisation of MRI. The aim of this report was therefore to identify strategies and opportunities to decrease inappropriate use of MRI in Austria.</p>
<p>Forschungsfragen:</p> <p>Kriterien für Angemessenheit/ Unangemessenheit</p> <p>Empfehlungen gegen den Einsatz von MRT</p> <p>Steuerungsinstrumente zur Reduktion unangemessener Anwendung</p> <p>derzeitige Anwendung und Kontrolle der MRT in Österreich</p>	<p>The following research questions were addressed:</p> <ol style="list-style-type: none"> 1. Which criteria define ‚appropriateness/inappropriateness‘ of MRI for diagnosis and screening? 2. What recommendations exist regarding circumstances and indications in which MRI should explicitly not be used? 3. Which instruments and regulatory mechanisms are recommended to tackle the problem of inappropriate imaging? What evidence is available on the effectiveness of those interventions on reducing inappropriate use of MRI? 4. How is MRI currently being used in Austria: which criteria and mechanisms are applied for controlling the utilisation of existing MRI scanners?

2 Background

2.1 MRI: technology, advantages and disadvantages

The basis of MRI is a resonance phenomenon: if an external magnetic field (formed by the MRI scanner) is applied, the magnetic moments of atomic nuclei are forced to align with the direction of this field. The strength of the magnetic field is measured in Tesla (T). Most commonly used MRI units are whole-body systems with magnetic field strengths of 1.5T or 3T [16].

The whole MRI system is managed and controlled by a computer system that also constructs, stores and analyses the final images.

MRI offers some advantages compared to other imaging techniques: First, no ionising radiation is used for MRI in contrast to *e.g.* computed tomography or X-ray. Physiological reactions to the non-ionising radiation do not accumulate over years as the effects of ionising radiation do [3]. Second, it has the ability to show metabolism and function in addition to anatomy and has a higher soft tissue contrast than computed tomography (CT) or ultrasound [3, 4], resulting in high sensitivity to disease [17]. Third, tomographic images of any plane can be provided without moving the patient. And forth, 2- and 3-dimensional images can be produced [16].

As no ionising radiation is used, MR imaging is generally considered a safe procedure [18, 19] that may also be used in pregnant women and children. The safety of MRI during pregnancy, in particular during the first trimester, is, however, not entirely proven and should therefore be thoroughly considered [17].

Due to its technical characteristics, application areas for MRI range from screening (*e.g.*, for ovarian cancer), initial diagnosis, follow-up and staging (*e.g.*, of prostate cancer) to monitoring (=surveillance; *e.g.*, for breast cancer recurrence).

- ❖ Screening is meant to look for conditions in patients without having symptoms of the respective condition, either generally or limited to persons with known risk factors.
- ❖ The initial diagnostic procedure is the first study performed to determine or exclude a specific disease in a person showing up with complaints or symptoms.
- ❖ A follow-up on the initial diagnostic procedure, *i.e.* a procedure performed subsequently, may be eligible if initially received results are non-specific and require further investigation.
- ❖ If the disease is already known but the severity and advancement is unclear, staging may help to plan further treatment and assess the state of the disease.
- ❖ Monitoring (or surveillance) is meant to observe changes over time in patients already known to have or suspected to have a certain disease. Patients are monitored to either check treatment adequacy and/or monitor for progression in severity of chronic diseases. After treatment, patients are monitored for side effects or recurrence of the disease [20].

Grundlage der MRT ist die Reaktion der Atomkerne auf ein externes Magnetfeld

die gängigste Magnetfeldstärke ist 1,5 oder 3 Tesla

Vorteile gegenüber anderen Methoden: keine ionisierende Strahlung, höherer Gewebe-Kontrast, Bilder mehrerer Ebenen und Dimensionen möglich

MRT gilt generell als sichere Untersuchungsmethode

die Anwendungsbereiche der MRT sind vielfältig:

Screening

Erstdiagnose

Follow-up

Staging

Überwachung

**spezialisierte
Anwendungen erweitern
den Einsatzbereich
der MRT:**

funktionelle MRT

**Magnetresonanz-
angiographie**

**Magnetresonanz-
spektroskopie**

Several specialised applications, like functional MRI (fMRI), MR angiography (MRA) and MR spectroscopy (MRS) provide an enhanced scope of application by offering added functionality and advantages compared to other technologies:

- ✦ Functional MRI is a neuroimaging technique used for non-invasive indirect measurement of neural activity and for imaging of activated cortical areas. As brain stimulation is correlated with an increase of metabolic activity of the respective brain area, human brain activity can be imaged due to changes in blood flow and volume.
- ✦ Magnetic resonance angiography (MRA) uses MRI methods in order to provide images of the blood vessel morphology [17]. In addition, MRA (in combination with MRI) is used to investigate blood volume flow, perfusion and velocity in the diagnosis of vascular diseases [16].
- ✦ MR spectroscopy is based on the physical principles of proton nuclear magnetic resonance spectroscopy. The technique is applied for the diagnosis of metabolic changes relating to developmental and pathologic neurological conditions [3].

**CT ist der MRT in
der Darstellung von
Knochenstrukturen,
des Respirationstrakts,
beweglichen Organen
und Kalkablagerungen
überlegen**

MRI is inferior to CT scanning in picturing bony structures (because of the low water and fat content of bone tissue), the respiratory tract and calcification of tissue (*e.g.*, in patients with osteoporosis). Also, the examination of moving organs (*e.g.*, the lungs, the heart or peristaltic movement) or acute patients (due to positioning and time issues) may be unfeasible. Due to increased blood emergence in the affected area, bone diseases like inflammation or tumours are, however, better detected by MRI when compared to CT or X-ray [3].

**es bestehen
Kontraindikationen
und Risiken**

Despite several advantages, some contra-indications, safety risks and potential adverse events – not only for the patient but also for staff and other persons in vicinity of the magnetic field [21] – need to be considered.

**Kontrastmittel sind
toxisch, gelten aber als
generell ungefährlich**

For several diagnostic questions, the intravenous application of a contrast agent is required to increase the sensitivity and specificity and, thus, the diagnostic accuracy of MRI. Although MRI contrast agents are reported to be rather safe, some adverse events (AEs) have been described in the literature due to their inherent toxicity [3]. The overall incidence of AEs for Gadolinium-based agents – the ones most commonly used in clinical practice – was reported to be between 0.17% and 0.48% [22, 23] and 0.93% respectively [24]. In the two former studies, 2-5% of those were classified as being severe [22, 23], whereas in the latter, none were [24]. Common non-allergic reactions include gastrointestinal disorders, nausea, headache and vomiting, whereas typical allergic reactions include hives and skin irritation. Rarely, life-threatening reactions such as chest tightness, respiratory distress and peri-orbital oedema can occur [3, 22, 23]. A relationship between the intravenous administration of the Gadolinium-based contrast agent gadodiamide and the occurrence of nephrogenic systemic fibrosis (NSF), a severe but rare disease occurring in patients with kidney dysfunction, has been described by the Food and Drug Administration (FDA) in 2010 [25].

**Nebenwirkungen sind
selten**

**mögliche Reaktionen
sind**

**Magenbeschwerden,
Übelkeit und
Kopfschmerz,
Ausschläge und
Hautirritationen**

**sehr selten kann
NSF auftreten**

**ferromagnetische
Gegenstände stellen
ein Risiko dar**

Ferromagnetic materials (*e.g.*, coins, keys, etc.) entering the inhomogeneous magnetic field of an MRI scanner pose a great risk to the patient, as they can become deadly projectiles [3, 26]. This requires that all persons entering the examination area are thoroughly screened for metallic objects.

Implants (*e.g.*, stents, prostheses) or other metallic objects (*e.g.*, bullets) may be a contraindication to MRI scanning if they contain ferromagnetic parts, possibly damaging surrounding tissue, vessels and nerves and/or the device itself [3, 27]. However, patients with certain ferromagnetic implants may undergo MRI examination with low magnetic field strength if the implant is held in place by retentive forces, will not heat a lot and does not threaten surrounding vital structures [28].

Intrauterine contraceptive devices (IUD) are usually made of plastic, containing an active Copper element. These objects are considered safe for patients using MR scanners operating at 1.5 Tesla or less [29].

Active implants or life-support systems (*e.g.*, pacemakers and cochlear implants) are contraindications to MRI scanning if their safety is not explicitly stated. The magnetic field can change or derogate their function, lead to excessive heating or damage certain components in addition to risks already mentioned above [27, 28]. However, several MRI-compatible pacemakers have already been developed and are brought to the market increasingly.

Severe burns at skin-to-skin contact zones can occur when the positioning of arms and legs of the patient creates a closed conductive loop. Additionally, contact with heated metallic objects (*e.g.*, metal in clothing, coils) may cause burns to the patient [3, 27]. In several studies, temporary and dose-related vertigo and nausea have been reported at field strengths higher than 2T [30, 31]. Claustrophobia and obesity are relative contraindications to MR imaging [17]. Table weight limits (~160kg-250kg depending on scanner type) and bore diameters (~60 cm) of MRI scanners may limit the usability of MRI for the evaluation of obese patients [32, 33].

ferromagnetische Implantate und metallische Objekte sind meist eine Kontraindikation

Intrauterinpressare gelten bei niedriger Feldstärke als sicher

Implantate wie Herzschrittmacher müssen explizit als sicher gekennzeichnet sein

weilers zu vermeiden sind Verbrennungen

Klaustrophobie und Übergewicht sind relative Kontraindikationen

2.2 Evidence based imaging

2.2.1 Clinical utility of diagnostic tests

The utility of any diagnostic test depends on the ability of the assay to improve clinical decision making and patient-relevant outcomes, as compared to the current test and treatment strategy. Patient-relevant outcomes are

- ✿ reduction of mortality,
- ✿ increased quality of life,
- ✿ reduction of adverse events and
- ✿ positive consequences resulting from the avoidance of further, potentially invasive tests or toxic therapies

Clinical utility of diagnostic imaging is rarely supported by high levels of evidence from randomised controlled trials (RCT) (Table 2.2-1). Instead most studies of diagnostic imaging focus on diagnostic accuracy. Diagnostic accuracy describes the correlation of test results with the results of a reference standard. The use of diagnostic accuracy estimates alone as surrogates for patient outcomes is, however, limited due to the following factors:

diagnostische Tests sind nützlich, wenn sie die Entscheidungsfindung unterstützen sowie patientInnenrelevante Outcomes verbessern

die meisten Studien zu diagnostischen bildgebenden Verfahren fokussieren auf diagnostische Genauigkeit

<p>diagnostische Genauigkeit allein ist als Parameter nicht ausreichend</p>	<ul style="list-style-type: none"> ✳ A widespread misconception is that high sensitivity and high specificity of a test translates in high certainty about the presence or absence of a condition in case of a positive or negative result. The probability for a certain health status after testing (the so-called post-test probability) is, however, dependent on the probability before testing (so-called pre-test probability). Even a very accurate test may add little to clinical management decisions if the pre-test probability for the tested condition is very low. Advanced imaging should therefore preferentially be used after evaluation of clinical history and physical examination by a specialist [14, 15].
<p>Vor-Test-Wahrscheinlichkeit ist entscheidend</p>	<ul style="list-style-type: none"> ✳ Diagnostic accuracy cannot be reliably estimated if no or only a poor reference standard is available and if not all study participants are tested with a reference standard. Only estimates from high quality diagnostic accuracy studies should be considered [34].
<p>ein guter Referenz-Standard ist nötig</p>	<ul style="list-style-type: none"> ✳ Diagnostic accuracy parameters only describe the capacity of a diagnostic procedure to identify one defined medical condition. Outside this original purpose, however, advanced medical imaging may produce incidental findings at often high rates. For example, in neurologically asymptomatic people, the crude prevalence of incidental findings on brain MRI is 2.7% or 1 in 37 [26]. Incidental findings are problematic, if there are no treatment options, as their discovery may have other harmful consequences for the patient, including anxiety or other implications such as e.g. loss of life insurance.
<p>Zufallsbefunde können gravierende Folgen haben</p>	<ul style="list-style-type: none"> ✳ Diagnostic accuracy parameters only describe the capacity of a diagnostic procedure to identify one defined medical condition. Outside this original purpose, however, advanced medical imaging may produce incidental findings at often high rates. For example, in neurologically asymptomatic people, the crude prevalence of incidental findings on brain MRI is 2.7% or 1 in 37 [26]. Incidental findings are problematic, if there are no treatment options, as their discovery may have other harmful consequences for the patient, including anxiety or other implications such as e.g. loss of life insurance.

Table 2.2-1: Evidence hierarchies by research questions

Evidence Level		Clinical utility for diagnostic research questions	Diagnostic Accuracy ³
High	I	Systematic reviews and RCTs with patient relevant outcomes	Diagnostic accuracy study with <ul style="list-style-type: none"> ✳ Independent blinded comparison ✳ Valid reference standard ✳ Consecutive patient sample ✳ Defined clinical presentation
Moderate	II	Studies on surrogate outcomes (Changes in patient management based on post-test probability)	Diagnostic Accuracy Study not meeting the criteria for level II; Diagnostic case-control study
Low	III	Studies on diagnostic accuracy	Diagnostic Accuracy Study with poor reference standard;
Very low	IV	Studies on technical accuracy	Study of diagnostic yield

Source: ([35-37])

derzeit laufen 14 RCTs zu MRT Currently, only 14 studies are registered at clinicaltrials.gov with the search terms „randomised controlled trial | Study type: Interventional Studies | Intervention: Magnetic resonance imaging” ([search results](#)).

³ This column only applies to reviews of diagnostic accuracy. For the evaluation of the impact of a diagnostic test on health outcomes, the “intervention” column should be used.

In summary, the appropriateness of an imaging test is defined not only by test performance characteristics for a clinical indication, but also of the potential negative consequences of imaging, an understanding of the implicit impact on clinical decision making, and an explicit understanding of how the test results might lead to care that could improve the patient's chances for better survival or improved health status [38].

2.2.2 Referral guideline development

With the Council Directive 97/43/Euratom European and International Legislation related to radiation protection requires effective justification of imaging tests involving radiation based on evidence-based guidance. As a consequence a process of developing imaging referral guidelines were initiated in all European Union (EU) member states, including Austria [39]. Due to the paucity of higher levels of evidence (Table 2.2-1), most guidelines base their recommendations on results from diagnostic accuracy studies and expert consensus. The total number of available guidelines on radiology are seen as a potential barrier for adoption and adherence, and proposed solutions include international cooperation to develop fewer, internationally agreed guidelines [40]. European referral guidelines are available, but are currently updated [41].

As part of the European Commission (EC) Imaging Referral Guidelines Project, a workshop amongst 60 participants formulated recommendations for future development of radiology guidelines in Europe [40]:

- ❖ Stronger measures should be taken by the EC and the European competent authorities for making Guidelines available and used in all EU member states.
- ❖ Evidence-based Guidelines with separate guidance for children should be issued or endorsed by a trusted European organisation.
- ❖ Educational initiatives and electronic requesting in connection with clinical decision support (CDS) systems should be used to improve the implementation of Guidelines.
- ❖ Monitoring of Guidelines implementation and use should be by clinical audit, particularly external audit, but also by local/internal audit.

Orientierungshilfe Radiologie (Austrian Orientation Guideline Radiology)

The Austrian Radiology Guideline was developed in 2011 and was edited by Verband für Bildgebende Diagnostik Österreich (Association imaging diagnostics Austria), Bundesfachgruppe Radiologie der Österreichischen Ärztekammer (Radiology expert group of the Austrian medical association), Österreichische Röntgengesellschaft (Austrian Radiology Association) and Verband für medizinischen Strahlenschutz Österreich (Association of medical radiation protection in Austria). It aims at supporting referring physicians, radiologists and other health care providers in making the right choices relating to the utilisation of diagnostic imaging procedures in clinical practice. In addition, it aims at forcing a unified imaging strategy throughout Austria to facilitate the best possible health care quality and the most reasonable resource allocation.

negative Konsequenzen sowie Auswirkungen auf die Entscheidungsfindung und auf die PatientInnen definieren die Angemessenheit bildgebender Verfahren

die Entwicklung von Guidelines zu bildgebenden Verfahren wurde in allen EU-Ländern initiiert

weniger, international anerkannte Guidelines wären zu empfehlen

Empfehlungen für zukünftige Guidelines beinhalten strengere Maßnahmen

separate Guidelines für Kinder

verschiedene Maßnahmen zur Implementierung und für das Monitoring

die Orientierungshilfe Radiologie wurde 2011 entwickelt

und soll ZuweiserInnen, RadiologInnen und andere Gesundheitsberufe in der Entscheidungsfindung unterstützen

Methoden zur Entwicklung beinhalten Literaturrecherche und ExpertInnenkonsensus

Various work groups conducted autonomous literature searches in Medline, the Cochrane Library, the National Institute for Health and Care Excellence (NICE) and radiology journals to identify relevant evidence serving as a basis for recommendations. In addition, the US-American ACR Appropriateness Criteria and recommendations from the Royal College of Radiologists (GB) were consulted. Formulated recommendations were reviewed by selected radiologists and nuclear medical scientists in Austria. Scientific societies accredited to the Austrian medical Association were consulted for comments [42].

Empfehlungen werden alle 4 Jahre aktualisiert und folgen 5 Kategorien

Updates of the recommendations are planned for every 4 years, meaning that a new version is scheduled to be published in 2015. Recommendations are rated according to 5 categories [42]:

- ✳ Indicated for initial diagnosis: should be applied primarily
- ✳ Indicated for follow-up diagnosis
- ✳ Indicated after observation: applies for clinical situations with symptoms that usually disappear after a certain period of time; utilisation is indicated when symptoms persist
- ✳ No routine indication: may be appropriate under certain circumstances
- ✳ Not indicated: no benefit to be expected

2.3 MRI in Austria

2.3.1 Regulation, planning and reimbursement

Medical equipment planning

der Österreichische Strukturplan Gesundheit - Großgeräteplan regelt den Einsatz medizinischer Großgeräte

MRI-devices are – among other large medical devices – planned centrally within the so called Austrian structural plan for large medical equipment („*Österreichischer Strukturplan Gesundheit-Großgeräteplan*“ 2012) [43]: within this plan the number of MRI scanners for the in- and outpatient health care sectors is regulated on the national and regional level. Economic, supply- and quality-related factors are considered to calculate maximum amounts and future needs. For Austria, the nearest MRI unit needs to be in 60 minutes reach, the population-related reference value is 1 unit/70,000-90,000 [43].

Regulations and reimbursement

Kostenerstattung für MRT ist intra- und extramural unterschiedlich geregelt

There are different modes of reimbursement for the inpatient MRI scans, for those performed in the ambulatory departments in hospitals, and in the outpatient sector, resulting in varying decision making processes and responsibilities (Figure 2.3-1).

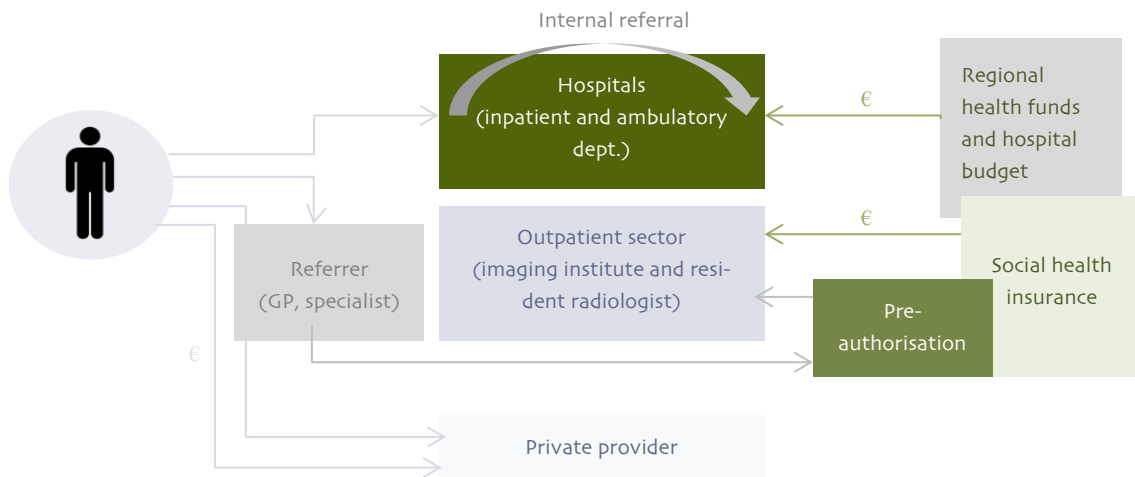


Figure 2.3-1: Referral and reimbursement processes in Austria

Hospitals, inpatient sector

- ❖ *Hospitals, inpatient sector:* MRI-scans are reimbursed within the Austrian hospital reimbursement system LKF/“Leistungsorientierte Krankenanstaltenfinanzierung” [44], that covers services in DRG/diagnosis-related-groups and – in cases of costly interventions such as MRI scans – additional tariffs are allocated for „individual medical procedures” (listed in the MEL/“Medizinische Einzelleistungen” benefit catalogue).
- ❖ Until recently (2013), MRI scans performed in the *ambulatory departments in hospitals* were covered by the overall allocated lump sum budget for those departments. Since 2014, an ambulant benefit catalogue is being piloted (listed in the KAL/“Katalog ambulanter Leistungen” benefit catalogue) with the intention to cover the true costs of the *ambulatory departments in hospitals*.
- ❖ MRI scans as „MELs” and as „KALs” are being documented in the hospitals’ standardised documentation system. MRI scans for inpatient patients are ordered by hospital clinicians, performed by the radiologists on duty and reimbursed within the LKF-system.
- ❖ In the *outpatient sector*, MRI scans are provided by independent outpatient clinics of radiology (imaging institutes in private practice). Costs for MRI are covered by social health insurance provided that the patient has been referred to the radiologist by a general practitioner or a specialist, that the examination has been pre-authorised by a head physician of the health insurance and that it is carried out using an MRI scanner listed in the Austrian structural plan for large medical devices. The Viennese section of social health insurance has disestablished the process of pre-authorisation for MRI examinations by September 2014 [45].

im stationären Bereich wird nach dem LKF-System vergütet

MRT fällt unter die MEL-Tarife

seit 2014 werden MRT in Spitalsambulanzen nach dem KAL vergütet

MELs und KALs werden nach dem LKF-System verrechnet

im extramuralen Bereich werden MRT von Diagnoseinstituten durchgeführt

für eine Kostenerstattung müssen bestimmte Voraussetzungen erfüllt werden

es besteht eine Deckelung in der Kostenerstattung
 seit Jänner 2014 ist das Ausgabenlimit an die Versicherungsbeiträge gekoppelt

MRT werden durch die Sozialversicherungen nach dem Organtarif vergütet

Kosten für privat bezahlte MRT sind höher

Kosten für ein MRT-Gerät hängen von verschiedenen Faktoren ab

2012 wurden rund 0,8 % der Gesundheitsausgaben für bildgebende Diagnostik ausgegeben

2013 waren 153 MRT-Geräte in Österreich im Einsatz

✳ The *social health insurances* reimburse the institutes on a *fee-for-service* basis, but only up to a *predefined cap of expenses*, independent of the frequencies of the examinations. With the intention of budget consolidation, an agreement between social insurances and outpatient MRI institutes was in place from 2009 to 2013, which restricted the ex-pense development of the institutes to 0.5%. As of January 1st, 2014 a new reimbursement framework was negotiated, that includes a yearly raise of the expense limit, concordant with the increase of total health insurance contributions [46].

✳ Average tariffs per scan reimbursed by *social health insurances* have decreased over the past years. MRI scans are reimbursed according to the so-called organ tariff: a pre-determined sum (roughly €150, [47, 48]) can be claimed once per day and per patient. For certain body areas (e.g. upper abdomen) the tariff can be multiplied by a factor of 1.9.

✳ Privately paid tariffs are usually considerably higher and depend on the body part that is being scanned.

The costs of an MRI scanner depends on various factors, including the field strength (usually ranging from 0.5T to 3T for clinical use), the type of magnet (e.g., permanent magnet, superconducting magnet) and the size/purpose of the scanner (e.g., suitable for whole body scans or only for extremity scans). Generally, costs range from about 120,000€ to about 1 million € [49].

In 2012, the overall expenditure on diagnostic imaging in Austria accounted for 243.9 million €, representing 0.8% of the total expenditure on health care [50, 51].

2.3.2 MRI utilisation in Austria

In 2013, a total of 153 MRI scanners were in use in Austria (excl. 16 MRI scanners with field strength of <1 Tesla), of which 93 were located in hospitals and 60 in the outpatient sector (Table 2.3-1). The numbers of MRI scanners in hospitals and outpatient imaging institutes were identified from the Medical equipment plan for large devices of the Ministry of Health [52].

Table 2.3-1: Numbers and location of MRI scanners in Austria

	Hospitals	Outpatient sector	Total
Equipment 2011	86	71	157
Equipment 2013	93	60	153

(Source: [52])

Daten zu MRT-Untersuchungen wurden von der OECD, vom HVB und vom BMG bezogen

Total numbers of MRI examinations (2009-2012) in the outpatient sector (outpatient imaging institutes) reimbursed by the social health insurers were provided by the Main Association of the Social Insurances. Data excluded numbers of *Versicherungsanstalt für Eisenbahnen und Bergbau* (VAEB) and *Sozialversicherungsanstalt der Bauern* (SVB). Total numbers of inpatient MRI examinations in public hospitals were provided by the Ministry of Health. Data on MRI examinations in hospitals, including ambulatory services provided by hospitals were retrieved from the OECD Health statistics [53]. The results are summarised in Table 2.3.-2 and Figure 2.3-2.

Table 2.3-2: Total numbers of MRI examinations in 3 sectors, average annual and overall percentage change, 2009-2012

	2009	2010	2011	2012	Average annual percentage change	Overall percentage change (2009-2012)
In hospitals, inpatient sector***	248,274	253,426	262,132	264,000	2.2%	6.3%
In hospitals, ambulatory department**	172,223	146,077	160,884	166,223	-1.1%	-3.5%
In outpatient sector*	554,321	562,783	574,411	576,450	1.3%	4.0%
Total	974,818	962,286	997,427	1,006,673	1.1%	3.3%

(* Source: HVB, **Source: OECD; *** Source: BMG)

Total numbers of MRI investigations in the hospitals, inpatient sector, increased from 248,274 to 264,000 between 2009 and 2012 (+6.3%). In the ambulatory setting of hospitals, numbers decreased from 172,223 to 166,223 between 2009 and 2012 (-3.5%). In the outpatient sector, examinations increased from 554,818 to 587,842 (+4.0%). Overall, there was an increase of 31,833 MRI examinations in Austria between 2009 and 2012 (+3.3%). Less than half of overall investigations are carried out in hospitals (Figure 2.3-2).

insgesamt stiegen 2009-2012 die Gesamtzahlen an MRT-Untersuchungen um 3,3 % an

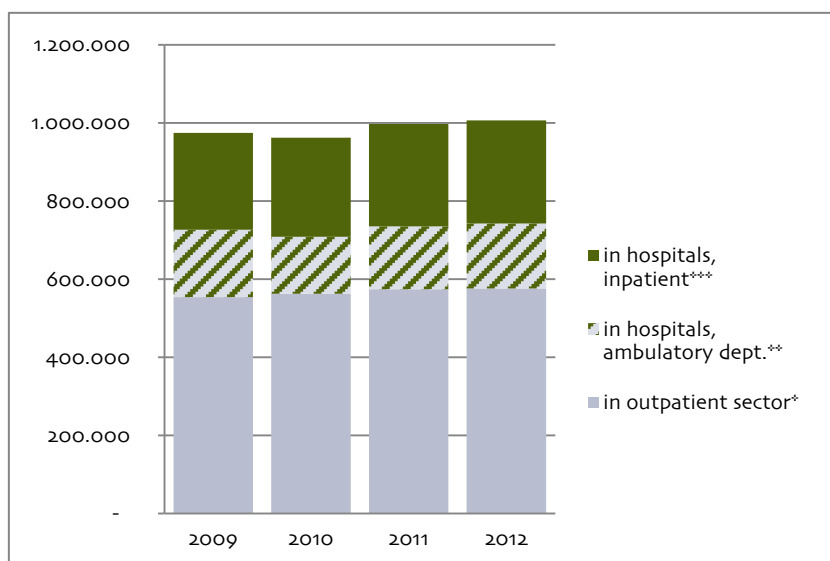


Figure 2.3-2: Total numbers of MRI examinations in 3 sectors, 2009-2012

Numbers of MRI examinations categorised to individual medical procedures (MEL) of the medical procedures catalogue were provided by the Ministry of Health. Similar data for the hospital ambulatory sector and the outpatient sector were not available. The results are summarised in Table 2.3-3 and percentage numbers are represented in Figure 2.3-3.

In 2012, more than a third of the investigations in the inpatient sector are MRI of the head and neck (36%); a fifth are MRI of the spine (19%), followed by MRI of abdomen and pelvis (11%), MR-angiography of head and neck (11%) and functional MRI (8%) (Figure 2.3-3).

Kopf und Hals-MRT machen 36 % der Untersuchungen aus

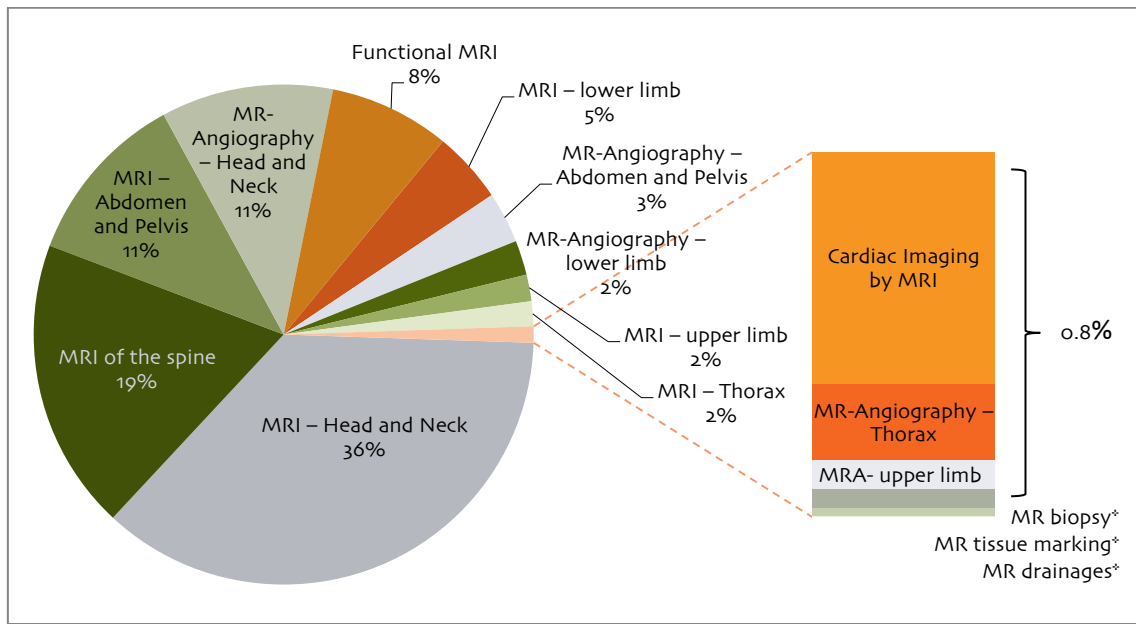


Figure 2.3-3: MRI Utilisation volumes by medical procedure (body part), 2012, Hospitals, inpatient sector. (Data source: BMG.* MR-guided organ biopsy; MR-guided preoperative tissue marking; MR-guided placement of therapeutic drainages.)

Table 2.3-3: Total numbers, average annual and overall percentage change of MRI exams by individual medical procedure (body part), Hospitals, inpatient sector; 2009-2012

Individual Medical Procedure	2009	2010	2011	2012	Average annual percentage change	Overall percentage change (2009-2012)
ZAO30 MRI – Head and Neck	90,182	89,395	94,530	96,183	2,2%	6,7%
ZN260 MRI of the spine	46,727	47,639	49,715	49,696	2,1%	6,4%
ZCO30 MRI – Abdomen and Pelvis	29,561	30,165	30,138	29,740	0,2%	0,6%
ZAO40 MR-Angiography – Head and Neck	23,180	25,883	28,151	29,387	8,3%	26,8%
ZN270 Functional MRI	18,052	19,885	19,902	20,566	4,5%	13,9%
ZE030 MRI – lower limb	13,228	12,717	12,722	12,232	-2,6%	-7,5%
ZCO40 MR-Angiography – Abdomen and Pelvis	9,045	9,055	9,043	8,737	-1,1%	-3,4%
ZE040 MR-Angiography – lower limb	6,991	6,466	6,242	5,909	-5,4%	-15,5%
ZDO30 MRI – upper limb	4,496	4,889	4,747	4,542	0,5%	1,0%
ZBO40 MRI – Thorax	3,877	4,338	3,920	4,266	3,7%	10,0%
ZBO60 Cardiac Imaging by MRI	1,577	1,824	1,846	1,743	3,8%	10,5%
ZBO50 MR-Angiography – Thorax	859	671	701	575	-11,8%	-33,1%
ZDO40 MR-Angiography – upper limb	299	273	263	216	-10,1%	-27,8%
ZNO40 Organ biopsy – MR-guided	108	154	144	139	10,9%	28,7%
ZNO80 Preoperative tissue marking – MR-guided	57	60	47	66	8,0%	15,8%
ZN110 Placement of therapeutic drainages – MR-guided	35	12	21	3	-25,5%	-91,4%
Total	248,274	253,426	262,132	264,000		

(Data source: BMG)

The five areas with highest volume also show in average positive change rates throughout 2009 to 2012 (Figure 2.3-4). Furthermore, MRI of the upper limb, MRI of the thorax and cardiac imaging represent small areas of utilisation, but with on average positive change rates from 2009 to 2012. MRI and MRA of the lower limb and MRA of abdomen and pelvis have on average negative change rates. MR guided drainage placement, biopsies and tissue marking, and MR angiography of thorax and upper limb are very marginal applications of MRI.

die fünf meistdurchgeführten Untersuchungen weisen auch positive Wachstumsraten auf

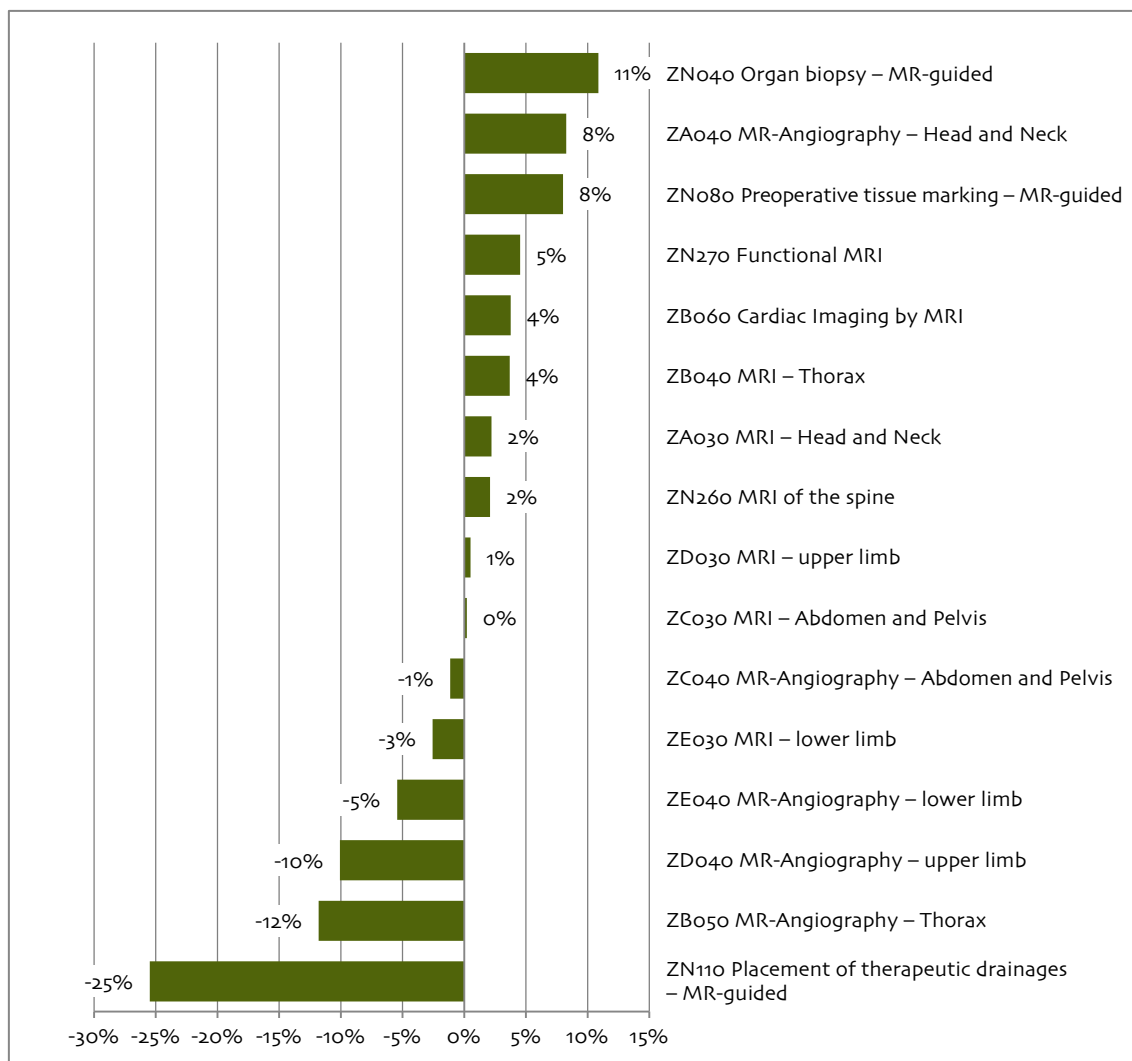


Figure 2.3-4: Average annual change in MRI utilisation 2009-2012 by medical procedure (body part), Hospitals, inpatient sector. (Source: Own presentation, data: BMG)

Austria is well above OECD average regarding the amount of MRI units per million population [54]: While the OECD average is 13.3 MRI units/million population (in 2011 or nearest year), 18.6 units/million population were registered for Austria in 2011 [43] (Figure 2.3-5). A limitation of this indicator is that the number of MRI units is not necessarily an accurate representation of the capacity to perform MRI examinations, as some of the units might be also dedicated research and not fully available for clinical investigations.

Österreich ist mit 18,7 MRT-Geräten/ 1 Mio. EinwohnerInnen über dem OECD-Durchschnitt

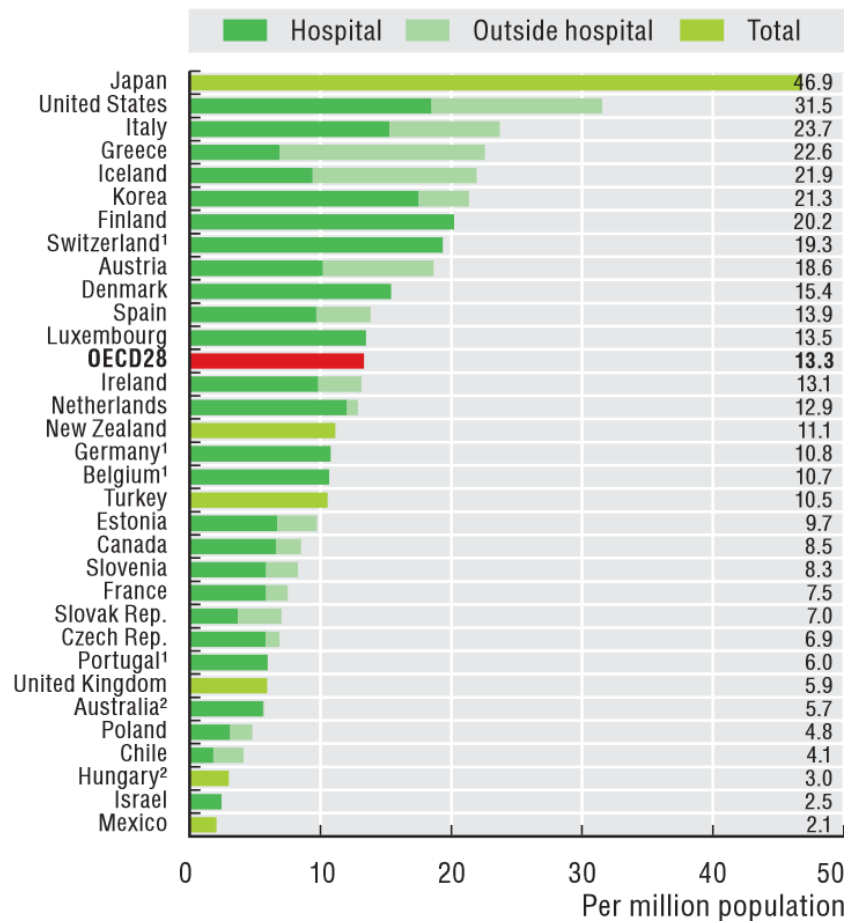


Figure 2.3-5: MRI units per Mio population in OECD countries (2011 or nearest year) (Source: OECD Health Statistics 2013, <http://dx.doi.org/10.1787/health-data-en>. <http://dx.doi.org/10.1787/888932917256>. ¹Equipment outside hospital not included, ²Only equipment eligible for public reimbursement.)

Österreich im OECD Vergleich führend bei MRT-Untersuchungen/1000 EinwohnerInnen

The second indicator for MRI utilisation is the number of MRI exams per 1000 population. In 2011, the OECD average was 55.5 exams per 1,000 population [54]. We retrieved the data on MRI utilisation in other OECD countries from OECD Health statistics [53]. Utilisation per 1,000 population in Austria was calculated based on population data from the OECD statistics [53]: in 2012, 119 MRI exams per 1,000 persons were reimbursed in hospital and outpatient settings. According to the OECD data set, Austria is among the countries with the highest frequencies of MRI exams per 1,000 population, jointly contributed by the hospital (including ambulatory services provided by hospitals) and outpatient sector (outpatient imaging institutes) [53] (Figure 2.3-6). An exam is defined „as a medical imaging session to study one (or more than one) body part that yields one or more views for diagnostic purposes” ([53]: Definitions, sources and methods). National jurisdictions might vary in the way the numbers of examinations are counted and thereby distort the comparison. In Austria, e.g., MRI and MRA in the same patient are counted separately and certain extensive examinations in one patient are recorded as 1.9 examinations.

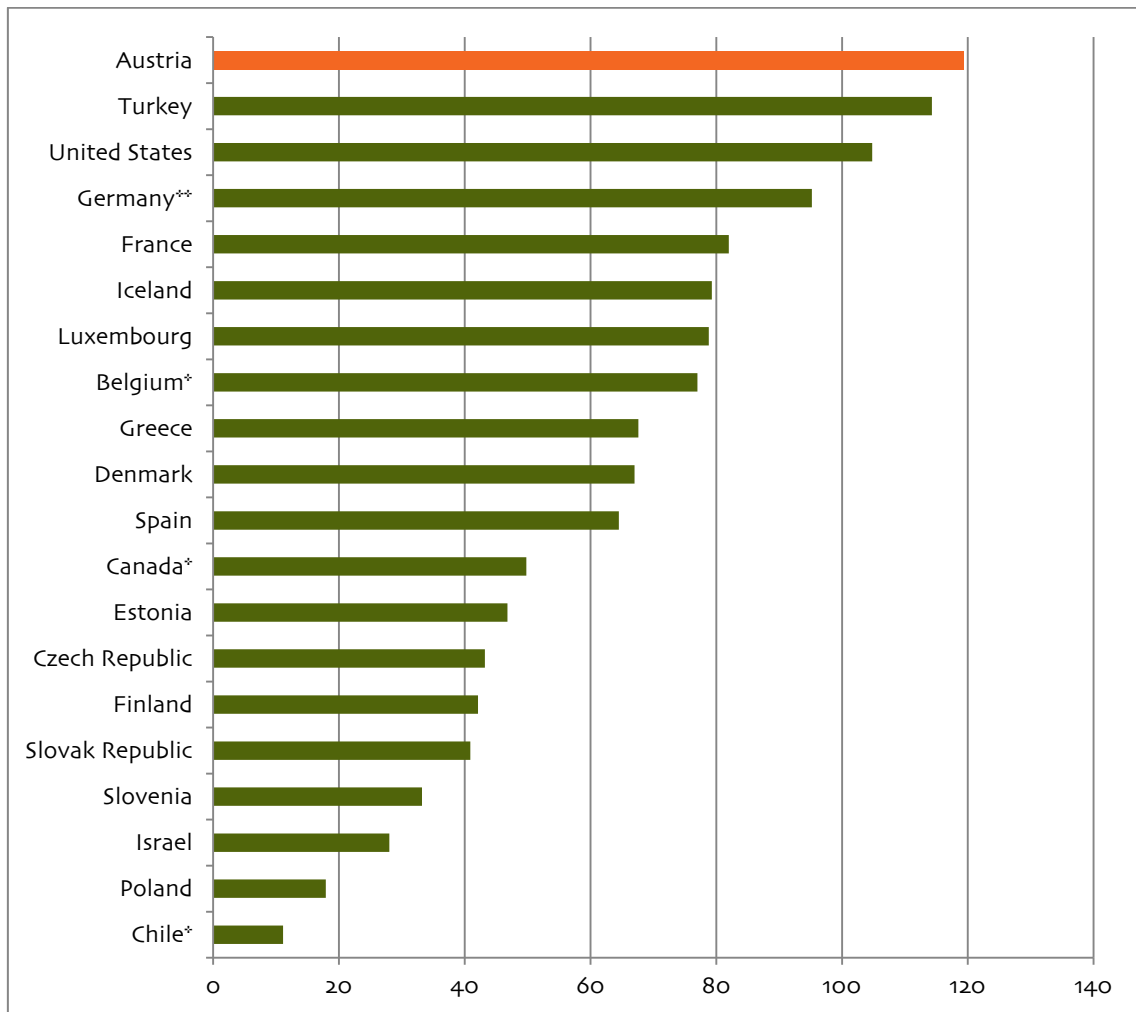


Figure 2.3-6: Total MRI exams per 1000 population in OECD countries (2012 or nearest year)
 (Sources: Own presentation with data from OECD health statistics [53] * Nearest year 2011; ** Nearest year 2009. Only countries were included where available data covered hospitals and outpatient setting.)

3 Methods

This report seeks to answer the following research questions:

1. Which criteria define ‚appropriateness/inappropriateness’ of MRI for diagnosis and screening?
2. What recommendations exist regarding circumstances and indications in which MRI should explicitly not be used?
3. Which instruments and regulatory mechanisms are recommended to tackle the problem of inappropriate imaging? What evidence is available on the effectiveness of those interventions on reducing inappropriate use of MRI?
4. How is MRI currently being used in Austria: which criteria and mechanisms are applied for controlling the utilisation of existing MRI scanners?

The following methods were applied.

Forschungsfragen:

**Kriterien für Angemessenheit/ Unangemessenheit
Empfehlungen gegen den Einsatz von MRT
Steuerungsinstrumente zur Reduktion unangemessener Anwendung
derzeitige Anwendung und Kontrolle der MRT in Österreich**

3.1 Criteria for appropriateness/inappropriateness in diagnosis and screening

To identify criteria that define the appropriateness or inappropriateness of MRI in diagnosis and screening (1st research question), a hand search was performed in relevant journals and on HTA websites in June 2014 [55-60]. In addition, articles that were identified to answer the 3rd research question (see chapter 3.3) and literature describing the programmes that were identified for answering the 2nd research question (see chapter 3.2) were consulted to address this question. Besides, definitions were derived from the *Preventing Overdiagnosis* Conference that was held in Oxford, UK, on the 15th to 17th September 2014.

Handsuche

Literatur zur Beantwortung der anderen Forschungsfragen

Konferenz

3.2 Systematic search for recommendations against the use of MRI

To identify evidence-based recommendations regarding circumstances and indications in which MRI should explicitly not be used in clinical practice, 6 publicly accessible and searchable resources have been systematically searched in May, June and August 2014 using the search terms magnetic resonance imaging, MRI, imaging, MRA, MR angiography and scan:

systematische Suche in 6 ausgewählten Programmen

- ✧ The Top 5 lists of the US-American Choosing Wisely® campaign
- ✧ The Top 5 lists of the Choosing Wisely Canada campaign
- ✧ The UK-based NICE ‘Do not do’ database and NICE referral advice database
- ✧ The Appropriateness Criteria® of the US-American College of Radiology

<p>unsystematische Handsuche zur Auswahl der Programme</p> <p>Einschlusskriterien:</p> <p>öffentlich zugänglich</p> <p>aktuell</p> <p>Methodenbeschreibung</p> <p>MRT berücksichtigt</p>	<ul style="list-style-type: none"> ✿ The CAR Referral Guidelines ✿ The ACCF Appropriate Use Criteria <p>These programmes have been identified by an unsystematic hand search on HTA websites, applying a snowball system.</p> <p>Inclusion criteria were:</p> <ul style="list-style-type: none"> ✿ public availability ✿ up-to dateness of recommendations (≤ 8 years) ✿ either German or English language ✿ a published description of evidence-based methods used for compiling the recommendations, and ✿ the inclusion/consideration of diagnostic procedures (<i>i.e.</i> at least 1 recommendation regarding MRI utilisation available).
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Table 3.2-1: Programmes, dates and amount of recommendations identified

Programme	Weblink	Date	Amount of recommendations identified
Choosing Wisely® USA	http://www.choosingwisely.org/	May 2014	29
Choosing Wisely Canada	http://www.choosingwiselycanada.org/	May 2014	8
NICE 'Do not do' recommendations and Referral Advice databases	http://www.nice.nhs.uk/usingguidance/donotdorecommendations/index.jsp http://www.nice.nhs.uk/usingguidance/referralladvice/search.jsp	May 2014	28
The ACR Appropriateness Criteria®	https://acsearch.acr.org/list	June 2014	160
The ACCF Appropriate Use Criteria	http://www.cardiosource.org/Science-And-Quality/Quality-Programs/Imaging-in-FOCUS/ACC-Appropriate-Use-Criteria.aspx	August 2014	8
The CAR Diagnostic Imaging Referral Guidelines	http://www.car.ca/en/standards-guidelines/guidelines.aspx	August 2014	17

<p>Empfehlungen zu MRT wurden in die Analyse eingeschlossen, wenn sie explizit vom Einsatz der MRT abraten</p>	<p>In a next step, identified recommendations were included in the analysis according to two independent reviewers (JM, AK). Inclusion criteria were:</p> <ul style="list-style-type: none"> ✿ MRI-related content: recommendations were excluded if they only referred to (imaging) techniques other than MRI. Recommendations were included, however, when imaging in general was addressed. ✿ explicit recommendation against the use of MRI for certain indications or circumstances.
<p>Analyse zu Intervention, Zweck, Indikation, Fachgebiet und Überschneidungen</p> <p>Abgleich mit der Orientierungshilfe Radiologie</p>	<p>Selected recommendations were analysed considering the intervention, purpose and indication they describe, the medical specialty they are related to, and according to overlaps between the programs.</p> <p>In addition, recommendations were compared to the Austrian Orientation Guideline for Radiology. Since the OGR did not include protocol specifications, recommendations relating to specific MRI protocol (field strength, use of contrast agents) were not considered in the comparison. In the Austrian hospital and outpatient setting, various (international) guidelines are relevant and being used associated with MRI decision making (<i>e.g.</i>, the guideline on</p>

MRI quality assurance by the German Radiology Society⁴ and various guidelines by the German Working Group of the Scientific Medical Societies⁵ [Arbeitsgemeinschaft der Wissenschaftlichen Medizinischen Fachgesellschaften]). The Austrian Orientation Guideline Radiology is, however, among the most common and widely-used. Therefore, it serves as the Austrian standard to be compared with identified recommendations.

3.3 Literature review

To identify factors leading to inappropriate imaging and proposed interventions aiming at reducing inappropriate imaging by MRI, we performed a literature search in the following databases:

- ✿ Cochrane (23.06.14, 133 Hits)
- ✿ CRD (26.06.2013, 90 Hits)
- ✿ Embase (19.06.14, 483 Hits)
- ✿ Medline (23.06.2014, 598 Hits)

using the following keywords:

Imaging, MRI, magnetic resonance imaging, diagnostic imaging
AND

Overuse, overutilization, overdiagnosis

Appropriate use, appropriateness

Inappropriate use, unnecessary, inappropriateness

Utilization management

Appropriate use criteria, appropriateness criteria

Decision support

The database search was complemented by a hand search in the references of selected key articles [60-62] which yielded additional 15 references.

Inclusion criteria:

- ✿ Type of article: primary and secondary research, reviews, meeting reports
- ✿ Topic: Interventions targeting appropriateness of MRI utilisation – (as listed in the Effective Practice and Organisation of Care (EPOC) Taxonomy); factors leading to inappropriate use of MRI
- ✿ Language: English or German

Exclusion criteria:

- ✿ Type of article: conference abstracts, letters to the editor, etc.
- ✿ Topic: indication-specific appropriateness criteria, only referring to imaging methods other than MRI

The 1304 Hits of the database search were screened by title and abstract. 117 articles were selected and ordered as full text, of which 57 were excluded. From the remaining 60 articles the authors selected relevant parts by qualitative aspects, categorised them to interventions based on the EPOC taxonomy and summarised them in the present report.

Literatursuche in 4 Datenbanken

ergänzende Handsuche

Einschlusskriterien:

**Primär- und
Sekundärliteratur,
Reviews
Interventionen gegen
und Ursachen von
unangemessenem
Gebrauch der MRT**

60 Artikel wurden eingeschlossen

Anwendung der EPOC Taxonomie

⁴ <http://www.drg.de/de-DE/48/leitlinien>

⁵ <http://www.awmf.org/en/clinical-practice-guidelines.html>

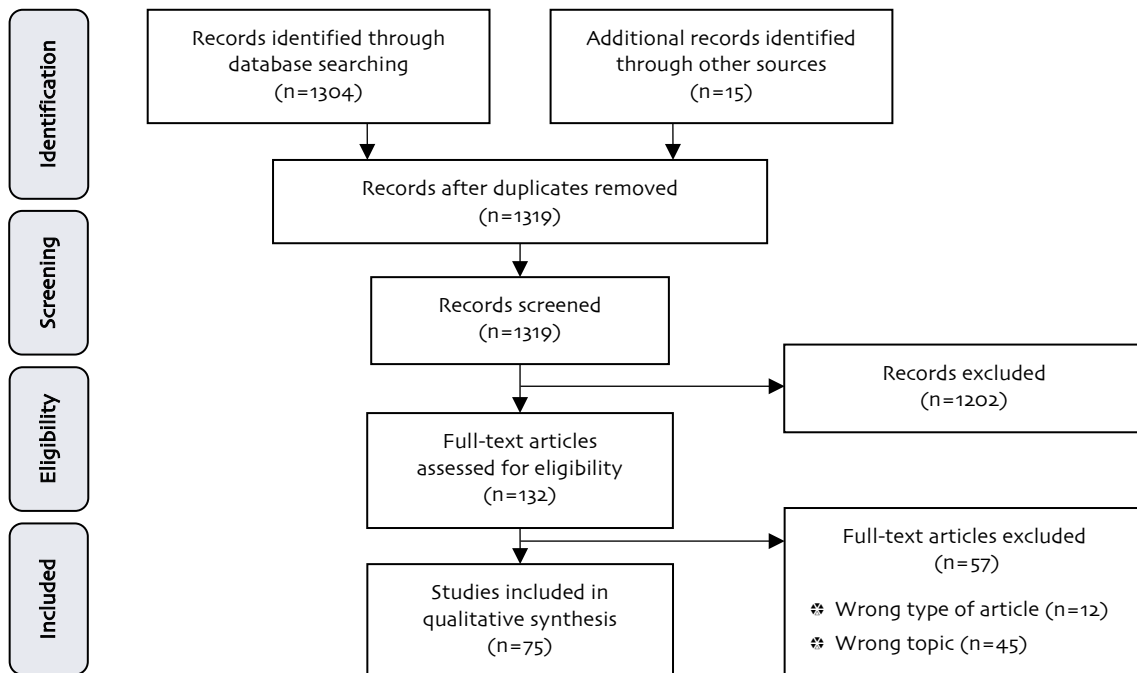


Figure 3.3-1: Prisma tree

3.4 Semi-structured interviews with stakeholders

Interviews mit Stakeholdern zur Einschätzung der Übertragbarkeit auf Österreich
semi-strukturierter Fragebogen

abgefragte Themen:

- Ursachen für ansteigenden MRT-Einsatz**
- Ursachen für unangemessenen MRT-Einsatz**

The authors were interested to contrast and align the results of the literature review with the opinions and experiences of Austrian stakeholders to assess the transferability of the results to factors and interventions to the Austrian context.

The interviews were conducted between 09 Sept 2014 and 10 Oct 2014 using a semi-structured questionnaire, with wording adapted to the different stakeholders.

Topics addressed were:

- ✦ Factors leading to increased imaging utilisation and/or need
 - ✦ demographic development, technological development, patient demand, referral demand
- ✦ Situations leading to inappropriate imaging utilisation
 - ✦ repeated investigation, investigation too early, wrong investigation, investigations with a highly unlikely or irrelevant positive result, incomplete referral information
- ✦ Instrumente/Prozesse/Instruments/processes in place or conceivable to contain inappropriate imaging utilisation
 - ✦ Guidelines, disinvestment recommendations, decision support tools, information exchange, refusal of imaging requests, pre-authorisation, monitoring, education

We identified the stakeholder groups involved in decisions on appropriate imaging, either in day-to-day practice with the patients or in utilisation management. These we identified to be:

- ✿ radiologists in outpatient setting
- ✿ radiologists in hospital setting
- ✿ health insurers
- ✿ health governmental representatives (medical equipment planning)
- ✿ referrers

We contacted representatives by a template invitation e-mail, in which they were informed about the general aims of the project, the function in which they were contacted and the following description of the aim and topic of the interview: „a practice-oriented insight in steering and control mechanisms currently used as a basis for decision making and referral processes“. We continued sampling until we had at least one representative for each stakeholder group. In total 16 stakeholders were contacted. five did not reply, two proposed a representative and one interview was cancelled due to conflicting schedule, leading to a final list of 10 interviewees (Table 3.4-1).

verschiedene Stakeholdergruppen wurden einbezogen

**RadiologInnen
Versicherungen
VersorgungsplanerInnen
ZuweiserInnen**

zumindest ein/e VertreterIn pro Stakeholdergruppe wurde befragt

insgesamt wurden 10 Interviews durchgeführt

Table 3.4-1: List of interview partners

Interview partner	Affiliation
Wolfgang Hofer	Leading radiologic technologist at Diagnosezentrum Urania (Diagnostic Center Urania), Vienna
Prim.Univ.-Prof.Dr. Gerhard Mostbeck	Otto-Wagner Spital, Vienna Wilhelminenspital, Vienna Erw. Präsidium Österreichische Röntgengesellschaft
Dr. Christian Euler	Österreichischer Hausärzterverband (Austrian association of general practitioners)
Prim. Univ. Doz. Dr. Thomas Rand	Bundesfachgruppe Radiologie der österreichischen Ärztekammer – BURA (Expert group on radiology at the Austrian medical association) Krankenhaus Hietzing, Vienna Präsidium Österreichische Röntgengesellschaft
Dr. Eva Maria Kulcsar-Mecsery	General practitioner
Dr. Susanne Rabady	Österreichische Gesellschaft für Allgemein- und Familienmedizin – ÖGAM (Austrian association of general and family medicine)
Mag. Stephan Mildschuh	Gesundheit Österreich GmbH – GÖG
Dr. Friedrich Vorbeck	Diagnosezentrum Donaustadt (Diagnostic center Donaustadt), Vienna Bundesfachgruppe Radiologie der österreichischen Ärztekammer – BURA (Expert group on radiology at the Austrian medical association) Präsidium Österreichische Röntgengesellschaft
Dr. Gottfried Endel	Hauptverband der Österreichischen Sozialversicherungsträger – HVB (Association of Austrian Social Insurance Institutions)
Univ.-Prof. Dr. Hannes Deutschmann	Universitätsklinik für Radiologie, LKH- Univ. Klinikum, Graz (Department of radiology, University hospital Graz)

Transcripts of the interviews were produced during the interviews, the transcripts were sent to the interviewees for approval.

Content of the transcripts was coded according to the framework set in the topic list and grouped using MAXQDA Version 11. Main messages of grouped citations were then translated in English.

MAXQDA Version 11 wurde zur Auswertung der Interviews verwendet

4 Results

4.1 Appropriate and inappropriate use of advanced medical imaging

4.1.1 Definitions, Causes and Effects

Appropriateness

According to the US-based Ambulatory Care Quality Alliance (AQA), the concept of „appropriateness“, as applied to health care, balances risk and benefit of a treatment, test, or procedure in the context of available resources for an individual patient with specific characteristics [63]. Basically, ‘appropriateness’ may be defined as a condition of expected health benefits of a health technology outweighing its expected negative outcomes, assuming that effective technologies may become inappropriate when over- or misusing them. Of note, a valid metric of the appropriateness of medical imaging does not only take into consideration spending but also utilisation [64].

Defining the appropriateness of diagnostic imaging, in particular MRI, for individual indications and in general is complex as it may vary with patient characteristics (*e.g.*, age and gender) as well as with the patients’ condition and symptoms [65]. In addition, the appropriate use of MRI is affected by structural conditions such as the availability of a technology [65] or qualified staff. Further influencing factors are the rapid development of imaging technologies [60] and increasing patient demand. Potential negative consequences of imaging include poor specificity with a high number of false positives, resulting in unnecessary further procedures [38]. For a sensible definition, the evaluation within well-defined clinical scenarios is required [2].

die Angemessenheit einer Behandlung oder eines Tests wird definiert durch Nutzen, Risiko, vorhandene Ressourcen und individuelle Charakteristika von PatientInnen

die Angemessenheit von MRT ist von einer Reihe von Einflussfaktoren abhängig

Inappropriate use: overuse/overutilisation, misuse and wasteful use

The inappropriate use of a certain technology may also include its overuse or misuse [66] and is often referred to as being ‘wasteful’. ‘Overuse/overutilisation’ is defined as the use of a technology more often than is indicated [55], not improving patient outcome at the same time [67], whereas ‘misuse’ can be described as the use of a technology for purposes other than those for which it was originally intended in the absence of evidence that doing so is clinically effective and cost-effective (for example, scope creep) [55]. Moreover, ‘waste’ in healthcare is being described as the excessive use of an otherwise effective intervention [56]. According to the European Commission Report [58], the chief causes of the wasteful use of radiology are:

- ✧ Repeating investigations which have already been done
- ✧ Investigation when results are unlikely to affect patient management
- ✧ Investigating too often
- ✧ Doing the wrong investigation
- ✧ Failing to provide appropriate clinical information and questions that the imaging investigation should answer
- ✧ Over-investigating

unangemessener Gebrauch beinhaltet auch falschen und übermäßigen Gebrauch

unangemessener Gebrauch kann verschiedene Ursachen haben

es gibt auch MRT-Anwendungen, die weder angemessen noch unangemessen sind

The use of MRI is not necessarily either appropriate or inappropriate – there also are applications considered ‘equivocal’, located between the two sides of the continuum (*e.g.*, indicated only under specific conditions), causing no difference in expected net health outcome for a certain clinical scenario [2].

Overdiagnosis kann zu negativen Konsequenzen wie unnötigen Behandlungen und Tests, Stigmatisierung und Angst führen

Overdiagnosis

Another aspect that is frequently mentioned in the context of MRI utilisation (and the use of other diagnostic technologies) is overdiagnosis. Overdiagnosis occurs when people without symptoms are diagnosed with a disease that ultimately will not cause them to experience symptoms or early death [57, 68]. More broadly defined, overdiagnosis refers to the related problems of over-medicalisation and subsequent overtreatment, diagnosis creep (...) and disease mongering, all processes helping to reclassify healthy people with mild problems or at low risk as sick [57, 69]. Overdiagnosis may cause harm inducing unnecessary labelling, unneeded tests and treatment, and wasteful resource allocation. Factors entailing overdiagnosis are multifaceted, including technological evolvement, cultural beliefs, commercial and professional vested interests, legal incentives and widened disease definitions [57]. A recent definition [70] describes overdiagnosis in cancer screening as the detection of cancers that, in the absence of screening, would not present symptomatically during one’s lifetime.

eigentlich gesunde Personen werden als krank klassifiziert zugrunde liegende Faktoren sind komplex

4.2 Identification of recommendations against the utilisation of MRI

4.2.1 Programmes and databases – methods and aims

unangemessener Einsatz bildgebender Verfahren hat negative Folgen auf Qualität, Sicherheit und Gesundheitsausgaben

The inappropriate use of imaging techniques is increasingly recognised as a serious concern regarding health care quality, patient safety and health care costs [71]. There is an ever-increasing amount of evidence on appropriate (and inappropriate) imaging utilisation, being translated into recommendations by a number of initiatives and programmes aiming at optimising quality and minimising waste to reduce the harm that results from unneeded examinations. As both physicians (general practitioners and specialists) and patients continuously need to assess the appropriateness of imaging procedures by making choices in routine practice, such recommendations can help identify and implement best practice care. The goals and methods of the programmes analysed for this report are described below. More detailed information about the Choosing Wisely® campaign USA and the NICE ‘Do not do’ Recommendations and Referral Advice Databases can be found in a previous report [72].

die Anzahl an verfügbaren Empfehlungen für ÄrztInnen und PatientInnen steigt an

The Choosing Wisely® campaign USA

die Initiative wurde 2009 gestartet und 2012 weiterentwickelt mehr als 50 teilnehmende Fachgesellschaften

The initiative was launched in 2009 by the National Physicians Alliance (NPA) and was further developed in 2012 when 9 specialty societies created lists of ‘Five things physicians and patients should question’, listing 5 evidence-based recommendations against the use of frequently applied procedures they considered inappropriate [73, 74]. Currently, more than 50 societies have joined the initiative which is under the patronage of the American Board of Internal Medicine (ABIM) Foundation.

The goal of the Choosing Wisely® campaign is to enhance conversation between patients and physicians about what treatment is appropriate and necessary, and to provide a tool to support adequate decision making. The initiative aims at reducing overuse, misuse and overtreatment and supporting optimal resource allocation [73].

Recommendations are formulated by using various methods, including evidence review, consensus building (*e.g.* using the Delphi Method) and online surveys. Criteria applied include effectiveness, cost/efficiency and benefit. In a next step, the identified tests and treatments are prioritised by the societies' members according to quite heterogeneous criteria (*e.g.*, available evidence, frequency of use, costs, appropriateness), using non-standardised methods [75]. The final Top-5 lists can be downloaded on the Choosing Wisely® website. In cooperation with Consumer Reports, patient-friendly resources covering a majority of the recommendations have been created to facilitate patients' engagement in the dialogue on appropriate healthcare.

Choosing Wisely Canada

Choosing Wisely Canada is based on the US-American Choosing Wisely® campaign and is managed in partnership with the Canadian Medical Association (CMA). The initiative is funded by the CMA, the University of Toronto, the Government of Ontario and The Commonwealth Fund [76].

Like the original initiative, Choosing Wisely Canada aims at ensuring high-quality care by supporting physicians and patients to have conversation about the appropriateness of tests and treatments, leading to smart decision making. Initially starting in Ontario in early 2014, the initiative is growing and currently includes Top-5 lists of 8 specialty societies.

There is no standardised set of methods neither for identifying inappropriate tests and treatments nor for creating the lists. For identification, methods include literature search and adaptations of the US-American lists whereas for prioritisation, surveys and consensus methods are used. The Top-5 lists, including all recommendations as well as patient-friendly material can be downloaded on the initiative's website.

The NICE 'Do not do' Recommendations and Referral Advice Databases

Since 1999, the National Institute for Health and Care Excellence (NICE) supports the National Health Service (NHS) in identifying 'low value' (*i.e.* ineffective, not evidence based) interventions in the UK health care system. In 2005, NICE has been given the mandate to develop a disinvestment programme by the Ministry of Health [77-79]. It was decided to integrate disinvestment activities in the routine guideline development, focusing on effectiveness, safety and costs [80].

Therefore, NICE deduces its 'do not do' recommendations and referral advice from existing guidance and NICE assessments [78]. There is no description of specific methods used for identification or prioritisation of inappropriate technologies and treatments available in the literature: The same HTA methods are used for investment and disinvestment guidance development [81]. Criteria applied include effectiveness, costs and efficiency [78].

Ziel ist die Reduktion unnötiger Gesundheitsleistungen

heterogene Methoden

Kriterien sind Effektivität, Kosten/Effizienz, Nutzen

Top-5-Listen werden online gestellt

basiert auf der US-Initiative

Start 2014

Ziel ist der Dialog über angemessene Versorgung

derzeit 8 teilnehmende Fachgesellschaften

heterogene Methoden

Top-5 -Listen werden online gestellt

NICE beschäftigt sich seit 2005 mit dem Thema Disinvestment

der Fokus liegt auf Effektivität, Sicherheit und Kosten/Effizienz

Empfehlungen beruhen auf bestehenden NICE Guidelines

**Empfehlungen sind in
2 Datenbanken online
öffentlich zugänglich**

Derived ‘do not do’ recommendations are fed into the 2007 established publicly available and searchable database that relates recommendations to the specific NICE guidance serving as a basis. Currently, more than 800 recommendations are stored in the database. As the reduction of inappropriate referrals additionally increases efficiency, a second searchable database includes NICE’s recommendations on referrals to secondary care [78].

The ACR Appropriateness Criteria®

**Guidelines in
Tabellenform**

The ACR (American College of Radiology) Appropriateness Criteria® (AC) are evidence-based guidelines in tabular form developed by radiology experts to support physicians in making appropriate imaging decisions for a range of clinical conditions. The guidelines aim at enhancing the quality of care and enable an effective and efficient use of imaging technologies in order to optimally use limited health care resources [82].

**Ziel ist die
Qualitätssicherung in
der Radiologie**

Start 1994

Development started in 1994 by the ACR Task Force on Appropriateness Criteria. Methods applied include systematic literature search, evidence review, expert consensus and input from other medical specialties. Each procedure in the Appropriateness Criteria® topics is rated by an expert panel relating to its appropriateness on an ordinal scale from 1 to 9 using a modified Delphi method.

**Bewertung durch
ExpertInnen anhand
einer 9-teiligen Skala**

**Bewertungen von
1-3 werden an
unangemessene
Untersuchungen
vergeben**

The median appropriateness ratings are displayed in the published tables: ratings 1, 2 and 3 represent ‘usually not appropriate’ (*i.e.*, under most circumstances, the study or procedure is unlikely to be indicated in these specific clinical settings, or the risk-benefit ratio for patients is likely to be unfavourable, as shown in published peer-reviewed, scientific studies supplemented by expert opinion [83]) whereas ratings 4-9 represent ‘may be appropriate’ or ‘usually appropriate’ [82, 83].

**derzeit sind
201 Krankheitsbilder
abgebildet**

Currently, 201 clinical conditions with 983 variants are publicly available on the ACR website, making the ACR Appropriateness Criteria® a comprehensive collection of evidence-based guidelines for appropriate diagnostic imaging. All topics are biennially reviewed and updated if necessary [82, 83].

The ACCF Appropriate Use Criteria

Start 2005

The American College of Cardiology Foundation (ACCF), in cooperation with other subspecialty societies, published the first set of the Appropriate Use Criteria (AUC) in 2005 [84]. During the ensuing years, the AUC have been updated and expanded, currently covering 8 exclusively cardiovascular-related topic areas.

**derzeit
8 kardiovaskuläre
Themenbereiche**

**Ziel ist die
evidenzbasierte und
effektive Nutzung
kardiovaskulärer
Verfahren**

The objective of the ACCF AUC is to actively promote evidence-based, effective use of cardiovascular technologies, including imaging, devices and procedures [84]. Thus, the AUC aim at defining when and how often a given procedure should be provided in the context of scientific evidence, the health care environment, patient needs and physicians’ judgement [85].

After literature review (including the review of relevant guidelines) and indication development by experts of multiple societies, a rating panel evaluates each procedure relating to its appropriateness in a standardised way, including a modified Delphi process. The rating categories range from ‘appropriate’ to ‘may be appropriate’ and ‘rarely appropriate’, representing a scale from 1 to 9 [84]. Recommendations are published online and are publicly available on the ACCF website. The AUC are updated following the update of underlying guidelines [84].

jedes Verfahren wird durch ExpertInnen anhand einer 9-teiligen Skala bewertet

Empfehlungen werden online gestellt

The CAR Diagnostic Imaging Referral Guidelines

The Canadian Association of Radiologists (CAR) Diagnostic Imaging Referral Guidelines, developed in 2012, are evidence-informed recommendations based on expert opinion or case studies. They are published on the CAR website in tabular form, aiming at assisting referring physicians and other health care professionals in making decisions about appropriate diagnostic imaging. Methods applied for compiling the recommendations include literature search and expert consensus in an expert advisory group [86, 87].

Start 2012

Empfehlungen basieren auf Expertenmeinung und Literatur

in Tabellenform online zugänglich

Inappropriate utilisation of diagnostic imaging is labelled with the term ‘not indicated’: Examinations which will usually not contribute to the management of the patient [86].

Terms labelling categories indicating that utilisation of diagnostic imaging may be inappropriate under certain circumstances [86]:

unangemessener Einsatz bildgebender Diagnostik wird durch 3 Kategorien dargestellt

- ✧ Not indicated initially: Includes situations where experience shows that the clinical problem usually resolves with time, and where deferring the study is suggested.
- ✧ Indicated only in specific circumstances: Non-routine studies to be carried out if a physician provides cogent reasons or if the radiologist feels the examination represents an appropriate way of furthering the diagnosis and management of the patient.
- ✧ Appropriate or equivocal applications of diagnostic imaging are labelled with either indicated or specialised investigation.

Table 4.2-1: Characteristics of identified programmes for recommendations against the use of MRI

	Choosing Wisely® USA	Choosing Wisely Canada	NICE 'Do not do' recommendations and Referral Advice databases	The ACR Appropriateness Criteria®	The ACCF Appropriate Use Criteria	The CAR Diagnostic Imaging Referral Guidelines
Country	USA	Canada	United Kingdom	USA	USA	Canada
Initiator	National Physicians Alliance (NPA)/American Board of Internal Medicine (ABIM) Foundation	Canadian Medical Association (CMA)	UK Ministry of Health	American College of Radiology (ACR)	American College of Cardiology Foundation (ACCF)	Canadian Association of Radiologists (CAR)
Methods	Not standardised; e.g., literature search, Delphi method, online survey	Not standardised; e.g., literature search, expert consensus	Standardised; HTA methods, NICE guidance as a basis	Standardised	Standardised; literature search and review, expert consensus, Delphi method, face-to-face meeting	Standardised; literature search, expert consensus
Use of Guidelines	Unsystematically (US-American, English)	Unsystematically (Canadian, US-American, English)	NICE guidelines; indirect: other current guidelines	Systematically (mostly US-American, Canadian)	Systematically (mostly ACCF/AHA practice guidelines)	n/a
Dissemination	Top-5 lists; published online Patient-friendly material; published online, via Consumer Reports	Top-5 lists; published online Patient-friendly material; published online	Publicly available and searchable databases; online Monthly 'recommendation reminders'; sent out actively to physicians and NHS managers	Guidelines in tabular form; published online	Guidelines in tabular form; published online	Guidelines in tabular form; published online
Update methods	n/a	n/a	Update or replacement as new guidance is published	Biennial review and update if necessary	Update as underlying guidance is updated	n/a

n/a – not applicable

4.2.2 General Results

A total of 293 recommendations have been identified from the 6 programmes. 253, relating to the inappropriate use of MRI and advanced medical imaging, were included in the analysis. The majority of recommendations (64%) derive from the ACR Appropriateness Criteria®, 12% from Choosing Wisely® USA and 11% from the NICE databases. The CAR Referral Guidelines, the ACCF Appropriate Use Criteria and Choosing Wisely Canada account for the remaining 13%.

**insgesamt wurden
253 Empfehlungen
analysiert**

**der Großteil stammt
von den ACR
Appropriateness Criteria**

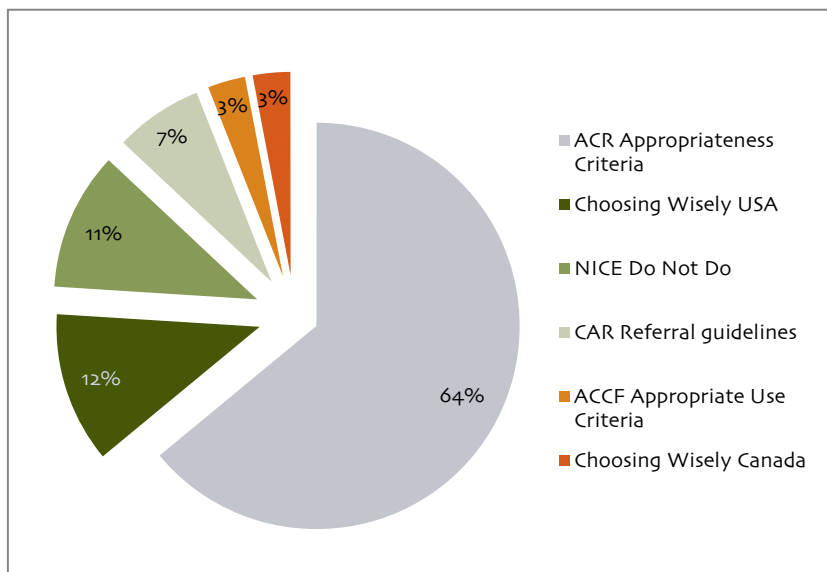


Figure 4.2-1: Percentage of recommendations against MRI use contributed per programme

Recommendations against MRI use can be classified according to 12 medical fields. The analysis shows that most nominations of inappropriate use fall in the field of Oncology (27%). In the oncological field, several recommendations relate to tumour staging (e.g., bladder cancer, uveal melanoma, bronchogenic carcinoma) or screening (e.g., for distant metastases in patients with testicular cancer). The inappropriateness of MRI utilisation may relate to a very low incidence of metastasis in certain tumours, not resulting in changes to patient management but potentially yielding false positive results and leading to unnecessary further diagnosis and treatment, or to technical inferiority of MRI compared to other imaging methods (e.g., in staging NSCLC). Orthopaedics and Neurology are also strongly represented.

**Empfehlungen
beziehen sich auf
12 Fachrichtungen**

**die meisten
Empfehlungen beziehen
sich auf die Onkologie,
Orthopädie und
Neurologie**

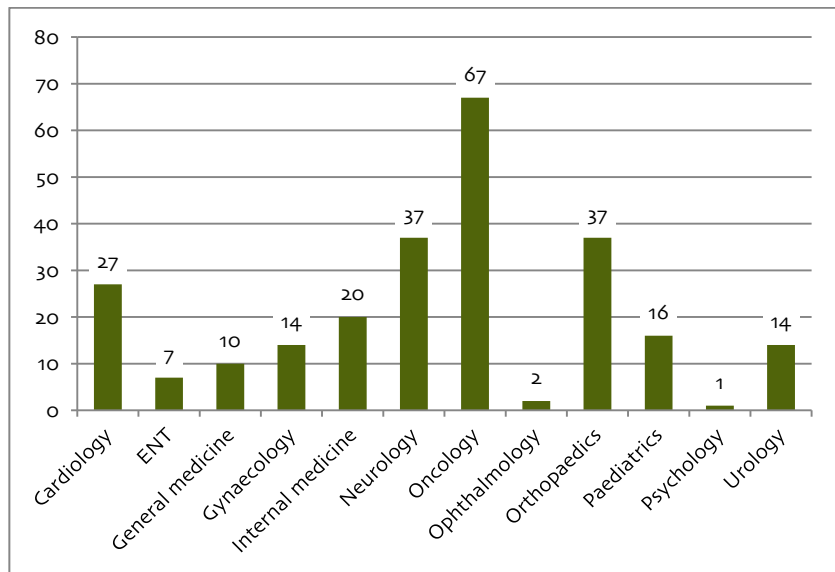


Figure 4.2-2: Identified recommendations against MRI use per medical field (absolute numbers)

**Empfehlungen zur
MRT des Kopfes machen
21 % aus**

**69 % der Empfehlungen
beziehen sich auf MRT
als Erstdiagnose**

Regarding body areas, MRI of the head is mentioned most often (21%) throughout the medical specialties in the recommendations, followed by heart, abdomen, pelvis, chest and spine. Most recommendations (69%) against the use of MRI refer to MRI as initial diagnostic method, whereas follow-up diagnosis, screening, staging or surveillance are mentioned less frequently. However, since the programmes do not systematically cover all indications, inappropriate procedures related to follow-up, staging or screening might be missed by the programmes.

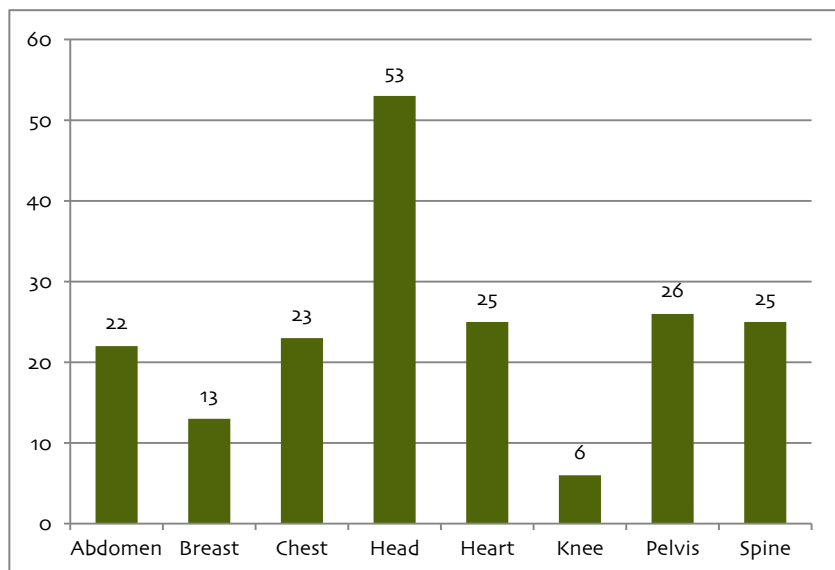


Figure 4.2-3: Identified recommendations against MRI use – distribution per selected body areas (absolute numbers)

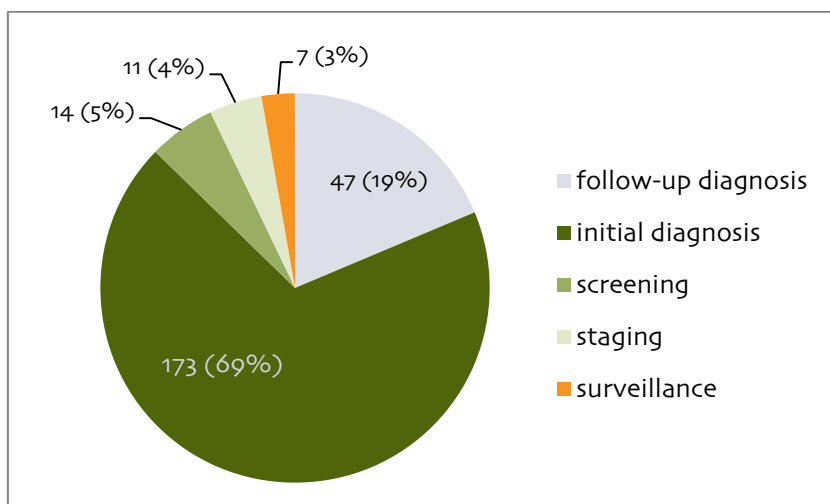


Figure 4.2-4: Identified recommendations against MRI use – distribution per purpose (absolute numbers and percentage)

On a more detailed level, e.g. in Oncology, MRI is also described as being inappropriate most often for initial diagnosis. However, when stratified by body parts, other purposes take the lead in certain cases.

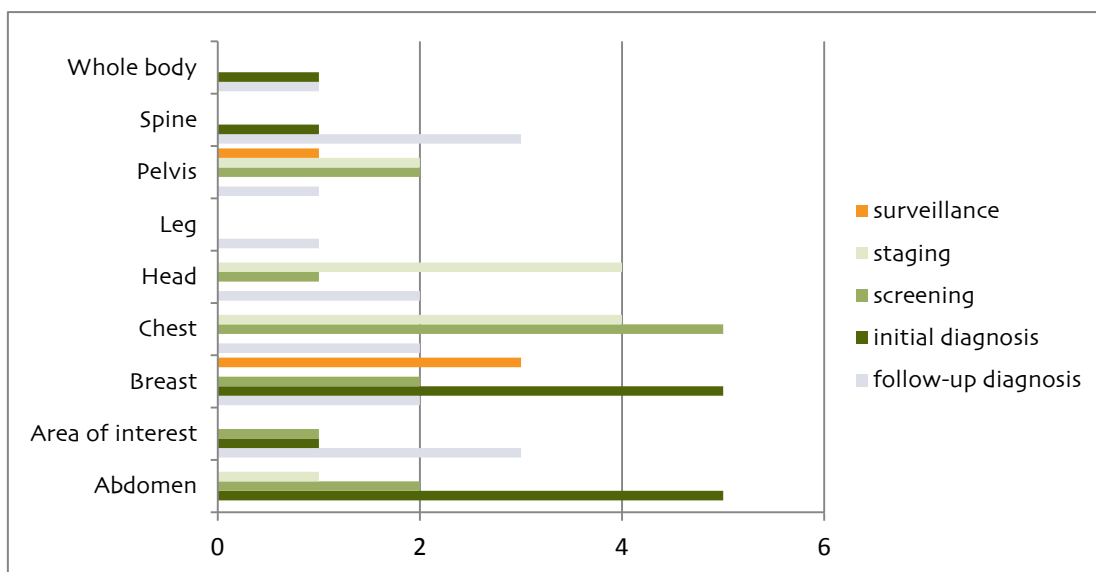


Figure 4.2-5: Recommendations against MRI use in Oncology – distribution per body parts and purpose (absolute numbers)

Overall, only 13 overlapping recommendations against MRI use were identified throughout the programmes (Table 4.2-2). Unsurprisingly, the highest rate of overlap exists between the Choosing Wisely® campaigns of USA and Canada: Choosing Wisely Canada is based on the US-American recommendations in large part. The highest degree of agreement was reached for the diagnosis of low back pain with no red flags present (mentioned by 4 programmes).

13 Überschneidungen zwischen den Programmen wurden identifiziert

Table 4.2-2: Overlapping recommendations against MRI use across medical fields

Indication	Intervention	Programmes
Initial diagnosis/primary investigation		
Headache: uncomplicated, no red flags or specific risk factors for structural disease	Imaging	CW CAN, CW USA
Low back pain: acute, non-specific, within first 6 weeks	Imaging lower spine	CW USA
Low back pain: no Red Flags ⁶	MRI lumbar spine	ACR AC, CW CAN, CW USA, CAR
Lower urinary tract symptoms: suspicion of benign prostatic hyperplasia	MRI pelvis resp. upper-tract imaging	ACR AC, CW USA
Pre-operative assessment in patients scheduled to undergo low-risk (or intermediate risk) non-cardiac surgery	(Stress) cardiac imaging or advanced non-invasive imaging	CW CAN, CW USA, ACCF AUC
Rhinosinusitis: uncomplicated, acute	MRI paranasal sinuses (and other imaging)	CW USA
Routine evaluation: no cardiac symptoms, no high-risk markers present	Stress cardiac imaging or advanced non-invasive imaging	CW CAN, CW USA
Seizures in children: simple febrile seizures and post-traumatic seizures resp. simple febrile seizures	MRI head resp. neuroimaging (MRI, CT)	ACR AC, CW USA, CAR
Sinusitis in children: uncomplicated, acute	MRI paranasal sinuses without (and with) contrast resp. imaging	ACR AC, CAR
Syncope: simple, in patients with a normal neurological examination	Neuro-imaging studies (MRI, CT)	CW CAN, CW USA
Follow-up		
Ductal carcinoma in situ, prior to definitive surgery	MRI breast	ACR AC, NICE DB
Routine follow-up in asymptomatic patients (e.g., every one to two years or at a heart procedure anniversary)	Annual stress cardiac imaging or advanced non-invasive imaging	CW CAN, CW USA
Staging		
Bronchogenic carcinoma: non- small cell and small cell lung carcinoma	MRI chest	ACR AC, CAR

3 Programme
beinhalten auch
Empfehlungen für MRT

The ACR AC, the CAR Guidelines and the ACCF AUC are not only focused on recommendations against the use of imaging in defined medical areas (so called 'do not do' recommendations) but also include appropriate or equivocal utilisation of technologies. Therefore, they provide a more comprehensive description of the appropriateness of e.g. MRI throughout different medical fields. However, the more focused approaches by Choosing Wisely Canada, CW USA and the NICE databases may better highlight those areas in which there is potential for improvement.

nicht alle Empfehlungen
differenzieren zwischen
Untersuchungen mit
und ohne
Kontrastmittel

In the ACR AC, procedures are differentiated between imaging with and without contrast. For some clinical conditions, MRI without contrast may be inappropriate but at the same time, it may be appropriate given that contrast is applied – and vice versa. In addition, a procedure being rated inappropriate under certain circumstances may be appropriate for other disease variants.

⁶ Red flags include: age <20 or >55 years, neurologic deficits, history of tumours, HIV infection, general illness, increasing pain etc. (cf. Orientierungshilfe Radiologie, accessed 7 November 2014, <http://orientierungshilfe.vbdo.at/empfehlungen/C/#7>).

Thus, it is crucial for physicians to always evaluate the actual circumstances and clearly define the clinical condition, consulting imaging recommendations as a decision support only.

In the chapters below, recommendations against MRI use are presented in a categorised and simplified way, lacking background information and reasoning. This information is available from the original references (*e.g.*, the ACR AC Narrative documents and NICE guidance documents related to the recommendations).

To increase the applicability for Austria, recommendations are categorised according to the 9 organ-related sections A to I of the Orientation Guide Radiology (OGR) edited by Verband für Bildgebende Diagnostik Österreich (Association imaging diagnostics Austria), Bundesfachgruppe Radiologie der Österreichischen Ärztekammer (Radiology expert group of the Austrian medical association), Österreichische Röntgengesellschaft (Austrian Radiology Association) and Verband für medizinischen Strahlenschutz Österreich (Association of medical radiation protection in Austria) that is commonly used in clinical practice in Austria.

Comparisons of the identified recommendations against MRI use with the OGR are complex because first, the Orientation Guide includes a rougher, higher-level classification according to organ-related sections and describes clinical conditions less differentiated than most of the analysed programmes do. Therefore, several recommendations had to be classified into umbrella terms (*e.g.*, the clinical condition of ‘spina bifida occulta’ is classified into ‘malformations of the spine’). In addition, not all clinical conditions included in the recommendations are represented in the OGR. Third, the OGR does not differentiate between MRI examinations with and without contrast application. The OGR also does not specify an MRI technique as angiographic, functional or spectroscopic imaging. Thus, comparing it one-to-one with the ACR AC or other programmes drawing a clear distinction between different applications is not always feasible. Of note, the OGR also does not specify the kind of neoplasm or setting in which imaging is justified to search for distant metastases. Overall, a direct comparison, due to recommendations being on the same level and relating to the same intervention and patient group, was possible for 60 clinical conditions.

Hintergrundinformation zu den Empfehlungen ist verfügbar

Empfehlungen sind anhand der 9 Kapitel A bis I der Orientierungshilfe Radiologie kategorisiert

der Vergleich mit der Orientierungshilfe Radiologie ist komplex und nur eingeschränkt möglich

ein direkter Vergleich war für 50 Empfehlungen möglich

4.2.3 Specific results by body part

Brain/Cranium

48 Empfehlungen
75 % beziehen sich auf
MRT als Erstdiagnose

Kopfschmerz und
Schädeltrauma werden
am häufigsten genannt

Overall, 48 recommendations related to inappropriate MR imaging of the brain and cranium were identified (Table 8-2). More than 75% relate to MRI as the initial diagnosis procedure, the rest concern follow-up, staging and screening. Headache and head trauma are the clinical conditions mentioned most often. Only 3 indications were included in more than one programme: uncomplicated headache, simple febrile seizures in children and simple syncope, with the strongest agreement existing for simple febrile seizures in children. For head trauma (excluding special cases), conductive hearing loss and simple febrile seizures in children, CT was described as being preferred to MRI due to its advantage in imaging bony structures.

23 Empfehlungen haben
eine Entsprechung in
der Orientierungshilfe
Radiologie

For 23 clinical conditions, a related recommendation in the OGR was identified. However, a direct comparison, due to recommendations being on the same level and relating to the same intervention and patient group, was possible for the following conditions only.

Matching recommendations against the use of MRI (Table 4.2-3):

- | | |
|--------------------------------------|---|
| Kopfschmerz | <ul style="list-style-type: none"> ✳ The CAR advise against MRI utilisation for diagnosing chronic/recurrent headache in the absence of focal features. CW USA rates neuroimaging studies as being inappropriate in patients with stable headache (meeting criteria of migraine) in the absence of neurologic findings. In the OGR, as well, MRI (or CT) is recommended only after observation in case focal features or changes of headache type occur. |
| Schädelverletzung bei Kindern | <ul style="list-style-type: none"> ✳ Children with moderate to severe head injury or a suspected non-accidental trauma or a subacute injury with neurologic signs following a head trauma should, as per ACR AC, not be diagnosed by head MRI with contrast. MRI head without contrast is, however indicated for all three conditions. In the OGR, MRI is rated appropriate as follow-up diagnosis for head injury. |
| Hörverlust | <ul style="list-style-type: none"> ✳ Both the OGR and ACR AC advise against MRI for the initial examination of hearing loss. |
| unkomplizierter Kopfschmerz | <ul style="list-style-type: none"> ✳ For uncomplicated headache in the absence of red flags, both CW USA and CW CAN advise against imaging. In the OGR, CT is recommended as initial diagnostic procedure for acute, severe headache. There is no analogy for ‘uncomplicated’ (<i>i.e.</i> no red flags present) described in the OGR. However, severity of headache is described as a red flag by CW CAN and acute and severe headache may be caused by subarachnoid hemorrhage, a potentially severe condition. MRI is recommended as follow-up in case of inflammatory reasons as it is more sensitive than CT. MRA is indicated for initial diagnosis of venous sinus thrombosis, demonstrating the more conservative approach of the OGR. |

Table 4.2-3: MRI – Brain/Cranium: Recommendations matching with OGR

Indication	MEL Code	Recommendation/Programme	Orientation Guide Radiology
Headache, chronic/recurrent: no focal features	ZA030	CAR: Headache chronic/recurrent: MRI indicated only in specific circumstances. In the absence of focal features imaging is not often helpful.	MRI indicated after observation in case of focal features and changes. A.6*
Headache: stable, meeting criteria for migraine	ZA030	CW USA: <i>Don't perform neuroimaging studies in patients with stable headaches that meet criteria for migraine.</i> Numerous evidence-based guidelines agree that the risk of intracranial disease is not elevated in migraine. However, not all severe headaches are migraine. To avoid missing patients with more serious headaches, a migraine diagnosis should be made after a careful clinical history and an examination that documents the absence of any neurologic findings such as papilledema. Diagnostic criteria for migraine are contained in the International Classification of Headache Disorders.	MRI indicated after observation in case of focal features and changes. A.6*
Head trauma in children	ZA030	ACR AC: Head trauma-child: MRI head with contrast for moderate – severe injury or suspected non-accidental trauma or subacute injury with neurologic signs; rated 2 <i>Comment: MRI head without contrast indicated for moderate to severe head injury or minor head trauma, suspected non-accidental trauma and sub-acute head injury.</i>	MRI indicated as follow-up for head injury. M.13*
Hearing loss: conductive	ZA030	ACR AC: Hearing loss/vertigo: MRI head and internal auditory canal without and with contrast for conductive hearing loss; rated 2 <i>Comment: CT of the temporal bone without contrast is the most appropriate initial imaging study in patients with conductive hearing loss.</i>	MRI indicated as follow-up. A.11*
Headache: uncomplicated, no Red Flags	ZA030	CW CAN: <i>Don't do imaging for uncomplicated headache unless red flags are present.</i> Red flags include recent onset, rapidly increasing frequency and severity of headache; headache causing the patient to wake from sleep; associated dizziness, lack of coordination, tingling or numbness, new neurologic deficit; and new onset of a headache in a patient with a history of cancer or immunodeficiency. CW USA: <i>Don't do imaging for uncomplicated headache.</i> Imaging headache patients absent specific risk factors for structural disease is not likely to change management or improve outcome. Those patients with a significant likelihood of structural disease requiring immediate attention are detected by clinical screens that have been validated in many settings. Many studies and clinical practice guidelines concur. Also, incidental findings lead to additional medical procedures and expense that do not improve patient well-being.	MRI indicated as follow-up, MRA indicated as initial diagnosis for acute, severe headache. A.5*

* refers to the respective chapter number in the OGR

Differing recommendations against the use of MRI (Table 4.2-4):

Kopfschmerz bei Kindern	✦ The ACR AC advise against head MRI in children with primary headache without neurologic signs or signs of increased intracranial pressure whereas according to the OGR, MRI is indicated as initial diagnostic method for headache in children.
Psychose	✦ NICE advises against MRI utilisation as a routine part of the initial investigations for the management of first-episode psychosis The OGR recommends MRI as initial diagnostic method to rule out organic reasons in patients with psychosis whereas.
Hirnmetastasen/ Lungenkrebs	✦ CW USA rate brain imaging an inappropriate method to screen for brain metastases in patients with suspected or biopsy proven Stage I NSCLC in the absence of neurologic symptoms, whereas the OGR generally describes MRI as the preferred method to diagnose brain metastases or follow up on them in patients with lung cancer.
Hirnmetastasen/ Nierenzellkarzinom	✦ The ACR AC advise against MRI of the head without and with contrast for post-treatment follow-up of brain metastases in asymptomatic patients with renal cell carcinoma. The OGR generally describes MRI as the preferred method to diagnose brain metastases.
Hirnmetastasen/ invasiver Blasenkrebs	✦ For pre-treatment staging in patients with invasive bladder cancer who have no neurologic symptoms, the ACR AC rate MRI of the head without and with contrast inappropriate to search for brain metastases. The reason is that neurologic complications are rare. The OGR generally describes MRI as the preferred method to diagnose brain metastases.
Hirnmetastasen/ Nierenzellkarzinom	✦ For renal cell carcinoma staging, the ACR AC advises against MRI of the head without and with contrast for the evaluation of brain metastasis if the patients do not have neurologic symptoms or other metastases. The OGR generally describes MRI as the preferred method to diagnose brain metastases.
Hirnmetastasen/ Aderhautmelanom	✦ The CAR advise against MRI of the brain in staging uveal melanoma stage I or IIA/B and stage IIC or III if no neurological symptoms are present as the incidence of brain metastases is very low. The OGR generally describes MRI as the preferred method to diagnose brain metastases.

Table 4.2-4: MRI – Brain/Cranium: Recommendations differing from OGR

Indication	MEL Code	Recommendation/Programme	Orientation Guide Radiology
Headache in children: primary headache	ZA030	ACR AC: Headache-child: MRI head without and with contrast for primary headache (chronic or recurrent, including migraine without permanent neurologic signs or signs of increased intracranial pressure); rated 3	MRI indicated as initial diagnosis. K.10*
Psychosis, first-episode	ZN270	NICE DB: Structural neuroimaging techniques (either magnetic resonance imaging [MRI] or computed axial tomography [CT] scanning) are not recommended as a routine part of the initial investigations for the management of first-episode psychosis.	MRI indicated as initial diagnosis. A.13*

Indication	MEL Code	Recommendation/Programme	Orientation Guide Radiology
Brain metastases: patients with suspected or biopsy proven Stage I NSCLC	ZA030	<i>CW USA:</i> <i>Patients with suspected or biopsy proven Stage I NSCLC do not require brain imaging prior to definitive care in the absence of neurologic symptoms.</i> ✦ The incidence of occult brain metastasis in Stage I lung cancer is low (<3%) and so routine brain imaging results in increased costs, delays in therapy and rarely changes patient management. ✦ False-positive studies occur in up to 11% of patients resulting in further invasive testing or incorrect over staging, with potentially tragic effects on treatment decisions and outcomes.	MRI indicated as initial diagnosis for assessing brain metastases.** L.27, L.7*
Renal cell carcinoma/Brain metastases in asymptomatic patients	ZA030	ACR AC***: Post-treatment follow-up of renal cell carcinoma: MRI head without and with contrast for asymptomatic patients; rated 1	MRI indicated as initial diagnosis for assessing brain metastases.** L.27*
Invasive bladder cancer/Brain metastases: lack of neurologic symptoms	ZA030	ACR AC***: Pre-treatment staging of invasive bladder cancer: MRI head without and with contrast; rated 2	MRI indicated as initial diagnosis for assessing brain metastases.** L.27*
Renal cell carcinoma/Brain metastases: no neurologic signs or other metastases	ZA030	ACR AC***: Renal cell carcinoma staging: MRI head without and with contrast; rated 1/3	MRI indicated as initial diagnosis for assessing brain metastases.** L.27*
Uveal melanoma/Brain metastases: Stage I or IIA/B	ZA030	CAR: Uveal melanoma staging Stage I or IIA/B: MRI brain not indicated. Incidence of metastases very low.	MRI indicated as initial diagnosis for assessing brain metastases.** L.27*
Uveal melanoma/Brain metastases: Stage IIC or III	ZA030	CAR: Uveal melanoma staging: Stage IIC or III with macrometastasis sentinel LN or LN dissection: MRI brain not indicated if no neurological symptoms.	MRI indicated as initial diagnosis for assessing brain metastases.** L.27*

* refers to the respective chapter number in the OGR

** The OGR does not specify any kind of neoplasm or setting when and if imaging is justified for the search of distant metastases; it states that MRI generally is the best method to assess brain metastases.

*** According to the ACR AC, MRI is, however, the recommended imaging technique for follow-up and retreatment of brain metastases and for their evaluation, particularly in patients being considered for surgery or radiosurgery. Therefore, the ACR AC do not rate MRI as being inappropriate to assess brain metastases in general, but identifies certain circumstances where MRI of the brain is not necessary.

Head/Neck

Overall, only 5 recommendations related to inappropriate MR imaging of the head and neck were identified, all relating to MRI as the initial diagnostic procedure (Table 8-3). Only 2 conditions were included in more than one programme: uncomplicated rhinosinusitis and uncomplicated sinusitis in children. For sinonasal disease and sinusitis in children, CT was described as being preferred to MRI.

5 Empfehlungen

alle beziehen sich auf MRT als Erstdiagnosemethode

2 Empfehlungen haben eine Entsprechung in der Orientierungshilfe Radiologie

Two related recommendations against the use of MRI were identified in the OGR. A direct comparison, due to recommendations being on the same level and relating to the same intervention and patient group, was possible for the following conditions.

Matching recommendations (Table 4.2-5):

- Sinusitis bei Kindern (unkompliziert)** ❖ Uncomplicated acute sinusitis in children. MRI is not indicated to diagnose uncomplicated acute sinusitis according to both the OGR, the ACR AC and CAR respectively.
- Sinusitis bei Kindern (kompliziert)** ❖ For complicated sinusitis in children, MRI of the paranasal sinuses and MRI head with contrast are suggested by ACR AC. The OGR rates imaging in general as not being a routine indication; however, MRI is suggested for atypical course or complications.

Table 4.2-5: MRI – Head and Neck: Recommendations matching with OGR

Indication	MEL Code	Recommendation/Programme	Orientation Guide Radiology
Sinusitis in children: uncomplicated, acute	ZA030	<p>CAR: Uncomplicated acute sinusitis in children: imaging not indicated. Mucosal thickening is frequently seen in asymptomatic children, limiting the value of imaging for ruling in/out sinusitis.</p> <p>ACR AC: Sinusitis-child: MRI paranasal sinuses without (and with) contrast; rated 1 <i>Comment: CT of the paranasal sinuses is the imaging modality of choice in patients with persistent, recurrent, or chronic sinusitis (ACR AC).</i></p>	MRI no routine indication. K.11*
Sinusitis in children, with complications	ZA030	<p>ACR AC: Sinusitis-child: MRI head without contrast for sinusitis with complications; rated 3 <i>Comment: MRI head with contrast and MRI paranasal sinuses indicated.</i></p>	<p>MRI no routine indication. <i>Comment: MRI may be indicated for atypical course and complications.</i> K.11*</p>

* refers to the respective chapter number in the OGR

Spine/Spinal cord

14 Empfehlungen Rückenschmerz wird am häufigsten genannt

Overall, 14 recommendations related to inappropriate MR imaging of the spine were identified, 12 relating to MRI as the initial diagnostic procedure and only one to each follow-up and screening (Table 8-4). Low back pain is the clinical condition mentioned most often, causing considerable overlaps between the programmes. Regarding myelopathy, CT was described as being the preferred first test in suspected spinal trauma as it is superior in evaluating the spine for fractures in the acute setting.

12 Empfehlungen haben Entsprechungen in der Orientierungshilfe Radiologie

For 12 clinical conditions, a related recommendation against the use of MRI was identified in the OGR. A direct comparison, due to recommendations being on the same level and relating to the same intervention and patient group, was possible for the following conditions.

Matching recommendations (Table 4.2-6):

- ❖ The OGR advises against MRI utilisation within the first 4-6 weeks of uncomplicated, acute low back pain without the presence of ‘red flags’. The ACR AC, CW CAN, CW USA and CAR reach the same conclusion. **unkomplizierter Rückenschmerz**
- ❖ Although the ACR AC rate MRI lumbar spine with contrast inappropriate for low back pain for patients over 70 years with specific symptoms, MRI without contrast is considered indicated. As old age is included in the list of ‘red flags’ in the OGR, MRI is indicated as initial diagnosis and/or follow-up. **Rückenschmerz**
- ❖ For chronic neck pain, the OGR suggests MRI as follow-up diagnosis in the presence of neurologic signs. The ACR AC, too, advises against MRI utilisation as first study. Following up on radiographs however, MRI is rated appropriate in the presence of neurologic signs, for suspected infection or malignancy or if the pain persists after the failure of conservative management. **chronischer Nackenschmerz**
- ❖ In low-risk patients with suspected spine trauma, the ACR AC advises against MRI of the cervical spine. There is a variety of clinical conditions described in the ACR AC, including various conditions for which MRI (primarily without contrast) is indicated. In the OGR, MRI is described appropriate as initial diagnosis or follow-up in case of neurologic deficits, considering that these may not be referred to as low-risk patients. **Wirbelsäulentrauma**
- ❖ The OGR suggests MRI for initially diagnosing congenital mutations, malformations, infections and metabolic diseases in children, indicating the necessity of sedation in neonates and infants (therefore, ultrasound may be the method of choice). In the CAR, MRI is rated inappropriate for following up on spina bifida occulta in the absence of neurological findings and cutaneous stigmata (after X-ray). In addition, screening for spinal dysraphism in low-risk infants is not recommended by the CAR due to the need for sedation. As the OGR and the CAR describe slightly different application areas, the recommendations are interpreted consistent. **kongenitale Veränderungen, Malformationen**

Table 4.2-6: MRI – Spine/spinal cord: Recommendations matching with OGR

Indication	MEL Code	Recommendation/Programme	Orientation Guide Radiology
Low back pain: no Red Flags	ZN260	<p>ACR AC: Low back pain: MRI lumbar spine without and with contrast if no red flags; rated 2</p> <p>CW CAN: <i>Don't do imaging for lower-back pain unless red flags are present.</i></p> <p>Red flags include, but are not limited to, severe or progressive neurological deficits or when serious underlying conditions such as osteomyelitis are suspected. Imaging of the lower spine before six weeks does not improve outcomes.</p> <p><i>Don't do imaging for lower-back pain unless red flags are present.</i></p> <p>Red flags include suspected epidural abscess or hematoma presenting with acute pain, but no neurological symptoms (urgent imaging is required); suspected cancer; suspected infection; cauda equina syndrome; severe or progressive neurologic deficit; and suspected compression fracture. In patients with suspected uncomplicated herniated disc or</p>	<p>MRI indicated after observation. Within the first 4-6 weeks, imaging is usually not indicated. C.6*</p>

spinal stenosis, imaging is only indicated after at least a six-week trial of conservative management and if symptoms are severe enough that surgery is being considered.

CW USA:

*Don't do **imaging** for low back pain within the first six weeks, unless red flags are present.*

Red flags include, but are not limited to, severe or progressive neurological deficits or when serious underlying conditions such as osteomyelitis are suspected. Imaging of the lower spine before six weeks does not improve outcomes, but does increase costs. Low back pain is the fifth most common reason for all physician visits.

CAR:

Lower back pain: **MRI** Indicated in special circumstances. Imaging is only indicated if there are „red flag“ indications.

<p>Low back pain: acute, non-specific, within first 6 weeks</p>	<p>ZN260</p>	<p>CW USA: <i>Avoid imaging studies (MRI, CT or X-rays) for acute low back pain without specific indications.</i> Imaging for low back pain in the first six weeks after pain begins should be avoided in the absence of specific clinical indications (e.g., history of cancer with potential metastases, known aortic aneurysm, progressive neurologic deficit, etc.). Most low back pain does not need imaging and doing so may reveal incidental findings that divert attention and increase the risk of having unhelpful surgery. <i>Don't recommend advanced imaging (e.g., MRI) of the spine within the first six weeks in patients with non-specific acute low back pain in the absence of red flags.</i> In the absence of red flags, advanced imaging within the first six weeks has not been found to improve outcomes, but does increase costs. Red flags include, but are not limited to: trauma history, unintentional weight loss, immunosuppression, history of cancer, intravenous drug use, steroid use, osteoporosis, age >50, focal neurologic deficit and progression of symptoms. <i>Don't obtain imaging studies in patients with non-specific low back pain.</i> In patients with back pain that cannot be attributed to a specific disease or spinal abnormality following a history and physical examination (e.g., non-specific low back pain), imaging with plain radiography, computed tomography (CT) scan, or magnetic resonance imaging (MRI) does not improve patient outcomes.</p>	<p>MRI indicated after observation. Within the first 4-6 weeks, imaging is usually not indicated. C.6*</p>
<p>Low back pain: patients over 70 years with specific symptoms</p>	<p>ZN260</p>	<p>ACR AC: Low back pain: MRI lumbar spine with contrast for patient over 70 years with specific symptoms; rated 3 <i>Comment: MRI lumbar spine without contrast indicated.</i></p>	<p>MRI indicated as initial diagnosis and after observation. C.7*</p>
<p>Neck pain, chronic</p>	<p>ZN260</p>	<p>ACR AC: Chronic neck pain: MRI cervical spine with contrast except suspected infection or malignancy; rated 1</p>	<p>MRI indicated as follow-up. C.4*</p>
<p>Neck pain, chronic</p>	<p>ZN260</p>	<p>ACR AC: Chronic neck pain: MRI cervical spine without and with contrast as first study; rated 1</p>	<p>MRI indicated as follow-up. C.4*</p>
<p>Spine trauma, suspected</p>	<p>ZN260</p>	<p>ACR AC: Suspected acute spine trauma: MRI cervical spine without and with contrast for low-risk patients; rated 1 <i>Comment: In case of e.g. myelopathy and for the evaluation of ligamentous injury, MRI cervical spine without contrast is indicated.</i></p>	<p>MRI indicated as initial diagnosis for cervical spine trauma, indicated as follow-up for lumbar spine trauma in case of neurologic deficit. M.15/16*</p>

Spina bifida occulta	ZN260	CAR: Spina bifida occulta reported on XR, neurological findings and cutaneous stigmata of dysraphism absent in children: imaging not indicated.	MRI indicated as initial diagnosis. K.1* MRI indicated as initial diagnosis or follow-up in older children when US is fruitless. K.14*
Spinal dysraphism, suspected in low risk infants	ZN260	CAR: Suspected spinal dysraphism, screening in low risk infants: MRI not indicated. MRI has the best diagnostic performance, but it requires sedation. It should therefore not be used as a screening modality.	MRI indicated as initial diagnosis. K.1* MRI indicated as initial diagnosis or follow-up when conspicuous/ unclear US, neurologic deficit, pre-OP. K.15*

* refers to the respective chapter number in the OGR

Musculoskeletal

Overall, 48 recommendations related to inappropriate MR imaging of the musculoskeletal system were identified and summarised in Table 8-5. They are further categorised according to body parts investigated: hand/wrist, foot, hip, knee, metastatic bone disease, joints, shoulder, soft tissue masses and stress fractures. Diagnosis of fractures and the evaluation of trauma and pain make up the bigger part of identified recommendations. More than 58% relate to MRI as the initial diagnosis procedure, the rest concern follow-up and screening.

For soft tissue masses with non-specific clinic, suspected distal radioulnar joint subluxation, chronic wrist pain and primary bone tumours (definitely benign lesions, not osteoid osteoma), CT was described as being preferred to MRI due to its advantage in avoiding motion artefacts, providing better positioning and shorter acquisition times and detection of mineralisation.

For 33 clinical conditions, a related recommendation in the OGR was identified. A direct comparison, due to recommendations being on the same level and relating to the same intervention and patient group, was possible for the following conditions.

Matching recommendations (Table 4.2-7):

- ✱ The ACR AC advise against MRI as initial diagnostic procedure for acute hand and wrist trauma. In the OGR, too, MRI is suggested as follow-up diagnosis.
- ✱ For acute trauma to the ankle, both the ACR AC and the OGR advise against the utilisation of MRI as first study – in the OGR, MRI is recommended as follow-up diagnostic procedure. The same applies for patients with acute trauma to the foot.
- ✱ In patients with avascular hip necrosis or chronic hip pain, MRI of the hips is not recommended as initial study by the ACR AC. The OGR recommends MRI as follow-up in patients with hip pain if radiographs are normal and femur head necrosis is suspected.

48 Empfehlungen

weiter kategorisiert nach Körperteilen

58 % beziehen sich auf Erstdiagnose

CT ist für einige Krankheitsbilder bevorzugt

33 Empfehlungen haben Entsprechungen in der Orientierungshilfe Radiologie

Hand- und Handgelenkstrauma

Knöcheltrauma

Hüftnekrose, Hüftschmerz

Knieschmerz	✳ For the initial examination of non-traumatic knee pain in adults , MRI is not indicated according to the ACR AC and CW USA. In the OGR, too, MRI is only suggested as follow-up diagnosis. CW USA indicates that if the pain persists, if there is recurrent swelling or if mechanical symptoms are present and radiographs are non-diagnostic, an MRI may be useful, though.
Brustkarzinom	✳ In patients with stage 1 or 2 carcinoma of the breast , the ACR AC advise against MRI as initial study. In case of hot spot(s) in the spine in asymptomatic patients, MRI spine with contrast is not recommended. However, MRI without contrast is indicated if radiographs are negative. According to the OGR, too, MRI is indicated as follow-up diagnosis to generally identify skeleton metastases.
Schulterschmerz	✳ Both the ACR AC and the OGR recommend the utilisation of MRI in patients with acute shoulder pain as follow-up diagnostic procedure only.
Stressfrakturen	✳ For diagnosing stress fractures, MRI is not suggested prior to radiographs according to the ACR AC. The OGR, too, suggests MRI as follow-up diagnostic procedure in case of negative radiographs.
Infektion nach Knie-Arthroplastie	✳ In patients who underwent total knee arthroplasty , MRI is not recommended as routine follow-up in asymptomatic patients or for diagnosing a suspected infection. MRI is, however, indicated as follow-up following radiographs. The OGR suggests MRI as follow-up diagnosis for suspected infections in patients with a painful implant if prior radiographs are negative.
Muskel-/Skeletttumore und Metastasen	✳ In patients with musculoskeletal tumours , MRI with contrast is not recommended for the evaluation of osseous metastatic disease according to ACR AC. MRI without contrast is, however, indicated. In the OGR MRI is rated appropriate in following up on skeleton metastases in general and for diagnosing, staging and controlling musculoskeletal tumours.
Weichteilmasse	✳ For soft tissue masses in patients with a non-specific clinical assessment , the ACR AC do not recommend MRI for initial examination. For other variants of this condition (<i>e.g.</i> , if a lipoma or a cyst is suspected) and in the follow-up, however, MRI is rated the appropriate diagnostic method. In the OGR, MRI is suggested as initial diagnostic procedure for delineation and staging of masses >5cm and for following up on non-specific ultrasound.

Table 4.2-7: MRI – Musculoskeletal: Recommendations matching with OGR

Indication	MEL Code	Recommendation/Programme	Orientation Guide Radiology
Hand and wrist trauma: acute	ZD030	ACR AC: Acute hand and wrist trauma: MRI wrist without and with contrast for wrist trauma, first examination; rated 1	MRI indicated for hand/wrist trauma as follow-up. M.28/29*
Ankle trauma, acute	ZE030	ACR AC: Acute trauma to the ankle: MRI ankle (without and) with contrast; rated 1	MRI indicated as follow-up. M.32*

Results

Hip necrosis	ZCo30	ACR AC: Avascular necrosis of the hip: MRI hips with or without contrast as initial study; rated 1 <i>Comment: MRI hips without contrast most sensitive method for detecting AVN, but not indicated before radiographs.</i>	MRI indicated as follow-up if radiographs normal and suspected femur head necrosis. D.14*
Hip pain, chronic	ZCo30	ACR AC: Chronic hip pain: MRI hip without and with contrast as first test; rated 1	MRI indicated as follow-up if radiographs normal and suspected femur head necrosis. D.14*
Knee pain: non-traumatic	ZE030	ACR AC: Non-traumatic knee pain: MRI knee without and with contrast as initial examination; rated 1	MRI indicated as follow-up. D.15*
Knee pain	ZE030	CW USA: <i>Avoid ordering a knee MRI for a patient with anterior knee pain without mechanical symptoms or effusion unless the patient has not improved following completion of an appropriate functional rehabilitation programme.</i> The most common cause of anterior knee pain is patellofemoral pain syndrome. Magnetic resonance imaging (MRI) is rarely helpful in managing this syndrome. Treatment should focus on a guided exercise programme to correct lumbopelvic and lower limb strength and flexibility imbalances. If pain persists, if there is recurrent swelling or if mechanical symptoms such as locking and painful clicking are present, and radiographs are non-diagnostic, an MRI may be useful.	MRI indicated as follow-up for knee pain. D.15*
Metastatic bone disease: stage 2 carcinoma of the breast with back and hip pain	ZN260	ACR AC: Metastatic bone disease: MRI hip and spine without and with contrast for stage 2 carcinoma of the breast with back and hip pain, initial presentation; rated 1	MRI indicated as follow-up for identifying skeleton metastases. L.29*
Metastatic bone disease: stage 1 breast carcinoma, hot spot/s in spine	ZN260	ACR AC: Metastatic bone disease: MRI spine with contrast for: stage 1 breast carcinoma, asymptomatic; single/three hot spot/s in spine, rated 1 <i>Comment: MRI without contrast indicated if radiographs are negative.</i>	MRI indicated as follow-up for identifying skeleton metastases. L.29*
Metastatic bone disease: stage 1 carcinoma breast	ZN660	ACR AC: Metastatic bone disease: MRI area of interest without and with contrast for stage 1 carcinoma breast, initial presentation, asymptomatic; rated 1	MRI indicated as follow-up for identifying skeleton metastases. L.29*
Shoulder pain: acute	ZDo30	ACR AC: Acute shoulder pain: MRI shoulder without contrast, best initial study; rated 1	MRI indicated as follow-up for traumatic shoulder pain. M.27*
Stress fracture, prior to X-ray	ZN660	ACR AC: Stress fracture: MRI area of interest without and with contrast as first study; rated 1	MRI indicated as follow-up. D.26*
Imaging after total knee arthroplasty	ZE030	ACR AC: Imaging after total knee arthroplasty: MRI knee without contrast as routine follow up in asymptomatic patients or initial evaluation of suspected infection; rated 1 <i>Comment: MRI indicated following radiographs.</i>	MRI indicated as follow-up for suspected infection in patients with painful implant if radiographs negative. D.16*

Musculo-skeletal tumors	ZN660	ACR AC: Follow up of malignant or aggressive musculoskeletal tumours for evaluation of osseous metastatic disease from musculoskeletal primary: MRI whole body without and with contrast; rated 1 <i>Comment: MRI without contrast is indicated.</i>	MRI indicated as follow-up for identifying skeleton metastases; Indicated as initial diagnosis, control and staging of musculoskeletal tumours. L.29, L.25*
Soft tissue masses: nonspecific clinic	ZN660	ACR AC: Soft tissue masses: MRI area of interest without and with contrast for initial examination, nonspecific clinic; rated 1 <i>Comment: Large lesions located on the abdominal or chest wall, where motion artefact can create suboptimal MR imaging, may be best evaluated with CT. MRI is, however, indicated for other variants of soft tissue masses.</i>	MRI indicated as initial diagnosis. D.4*

* refers to the respective chapter number in the OGR

Differing recommendations (Table 4.2-8):

Knie trauma	✱ The ACR AC advise against the use of MRI with and without contrast for initially diagnosing acute trauma to the knee for patients excluding infants who have no symptoms. In contrast, according to the OGR, MRI is generally indicated for initial diagnosis.
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Table 4.2-8: MRI – Musculoskeletal: Recommendations differing from OGR

Indication	MEL Code	Recommendation/Programme	Orientation Guide Radiology
Knee trauma, acute	ZE030	ACR AC: Acute trauma to the knee: MRI knee with and without contrast for patients (excluding infants) with no symptoms; rated 1	MRI indicated as initial diagnosis for knee trauma. M.31*

* refers to the respective chapter number in the OGR

Cardiovascular

25 Empfehlungen	Overall, 25 recommendations related to inappropriate MR imaging of the cardiovascular system were identified (Table 8-6). The evaluation of chest pain and coronary artery disease make up the bigger part of identified recommendations. 22 recommendations relate to MRI as the initial diagnosis procedure, the rest concern follow-up diagnosis.
Brustschmerz als meistgenanntes Krankheitsbild	For 3 conditions, overlaps between the programmes were identified: Pre-operative assessment in patients scheduled to undergo low-risk (or intermediate risk) non-cardiac surgery, the routine evaluation of low-risk patients and routine follow-up in asymptomatic patients.
11 Empfehlungen haben Entsprechungen in der Orientierungshilfe Radiologie	A related recommendation in the OGR was identified for 11 clinical conditions. However, a direct comparison, due to recommendations being on the same level and relating to the same intervention and patient group, was possible for the following conditions only.

Matching recommendations (Table 4.2-9):

- ✧ For suspected pulmonary embolism in patients with acute chest pain, MRA of pulmonary arteries is inappropriate according to the ACR AC. CW USA advises against imaging for suspected pulmonary embolism in patients without moderate or high pre-test probability for pulmonary embolism. The OGR, too, rates MRA no routine indication for diagnosing pulmonary embolism.

Pulmonalembolie

Table 4.2-9: MRI – Cardiovascular: Recommendations matching with OGR

Indication	MEL Code	Recommendation/Programme	Orientation Guide Radiology
Chest pain, acute	-	ACR AC: Acute Chest Pain — Suspected Pulmonary Embolism: MRA pulmonary arteries without contrast; adults, pregnant patients; rated 3	MRI no routine indication. E.19*
Pulmonary embolism (PE), suspected	ZBo4o	CW USA: <i>Don't image for suspected pulmonary embolism (PE) without moderate or high pre-test probability of PE.</i> While deep vein thrombosis (DVT) and PE are relatively common clinically, they are rare in the absence of elevated blood d-Dimer levels and certain specific risk factors. Imaging, particularly computed tomography (CT) pulmonary angiography, is a rapid, accurate and widely available test, but has limited value in patients who are very unlikely, based on serum and clinical criteria, to have significant value. Imaging is helpful to confirm or exclude PE only for such patients, not for patients with low pre-test probability of PE. <i>Comment: MRI is only used rarely for this indication; CTA with contrast is the standard technique.</i>	MRA no routine indication. E.19*

* refers to the respective chapter number in the OGR

Thorax

Overall, 16 recommendations related to inappropriate MR imaging of the thorax were identified (Table 8-7). Follow-up and screening for pulmonary metastases and nodules make up a big part of identified recommendations.

16 Empfehlungen

Overlaps between the programmes were identified only for the staging of bronchogenic carcinoma. Interestingly, the preference of CT (partly in combination with CTA) was described for 10 clinical conditions, particularly in follow-up, staging and screening: blunt chest trauma, chronic dyspnoea, pulmonary nodules, different variants of pulmonary metastases, bronchogenic carcinoma and NSCLC. Mentioned limitations of MRI include motion-related artefacts, a lower spatial resolution than CT, and an inability to detect calcification within lesions.

für 10 Krankheitsbilder gilt CT als bevorzugt

For 5 clinical conditions, a related recommendation in the OGR was identified. A direct comparison, due to recommendations being on the same level and relating to the same intervention and patient group, was possible for the following conditions.

5 Empfehlungen haben Entsprechungen in der Orientierungshilfe Radiologie

Matching recommendations (Table 4.2-10):

- Thoraxtrauma** ❖ In the evaluation of blunt chest trauma, both the ACR AC and the OGR advise against the utilisation of MRI as initial diagnostic method. According to the OGR, MRI is indicated as follow-up diagnostic for special issues.
- Stridor** ❖ For the initial diagnosis of acute stridor in children, imaging is not indicated according to CAR. According to the OGR, MRI is indicated as follow-up diagnostic procedure for acute and chronic stridor (particularly for diagnosing tumours and inflammatory masses).

Table 4.2-10: MRI – Thorax: Recommendations matching with OGR

Indication	MEL Code	Recommendation/Programme	Orientation Guide Radiology
Chest trauma, blunt	ZBo4o	ACR AC: First-line evaluation of blunt chest trauma; high-energy mechanism: MRI chest without (rated 1) and with (rated 2) contrast <i>Comment: CT chest with contrast, ideally performed with CTA, is indicated.</i>	MRI indicated as follow-up for chest trauma. F.2*
Stridor, acute	ZBo4o	CAR: Acute stridor, unstable child: imaging not indicated. Emergency airway management takes precedence over imaging.	MRI indicated as follow-up. K.28*

* refers to the respective chapter number in the OGR

Differing recommendations (Table 4.2-11):

- Thoraxtrauma** ❖ According to the ACR AC, MRI chest is not indicated as follow-up diagnostic procedure for blunt chest trauma in patients with normal anteroposterior chest radiograph, normal examination and normal mental status. According to the OGR, however, MRI is indicated as follow-up diagnostic for special issues (e.g., muscle avulsion).
- Lungenkarzinom** ❖ For staging bronchogenic carcinoma, MRI chest is not indicated according to the ACR AC and the CAR. NICE advises against routine MRI utilisation to assess the stage of the primary tumour (T-stage) in non-small cell Lung Cancer. In the OGR, however, MRI is indicated as follow-up diagnosis (following CT examination) for staging lung carcinoma in case of suspicion of infiltration of the pericardium, chest wall, central vessels spinal structures, Pancoast-Tumour.

Table 4.2-11: MRI – Thorax: Recommendations differing from OGR

Indication	MEL Code	Recommendation/Programme	Orientation Guide Radiology
Chest trauma, blunt	ZBo4o	ACR AC: Blunt chest trauma: MRI chest without (1) and with (2) contrast for patients with normal anteroposterior chest radiograph, normal examination and normal mental status, no high energy mechanism <i>Comment: Chest X-ray and CT/CTA are complementary first-line imaging modalities.</i>	MRI indicated as follow-up for chest trauma for special cases. F.2*

Bronchogenic carcinoma: non- small cell and small cell lung carcinoma	ZB040	ACR AC: Non-invasive clinical staging of bronchogenic carcinoma: MRI chest without and with contrast for non- small cell and small cell lung carcinoma; rated 3 CAR: Staging Small Cell Lung Cancer: chest MRI not indicated <i>Comment: CT of the chest (and abdomen) with contrast is rated most appropriate for staging.</i> <i>CAR: only Small Cell lung cancer</i>	MRI indicated as follow-up procedure for staging of lung tumour. L.7*
Non-small cell lung cancer	ZB040	NICE DB: Magnetic resonance imaging (MRI) should not routinely be performed to assess the stage of the primary tumour (T-stage) in non-small cell Lung Cancer (NSCLC). <i>Comment: Patients with known or suspected lung cancer should be offered a contrast-enhanced chest CT scan to further the diagnosis and stage the disease.</i>	MRI indicated as follow-up for staging of lung tumour. L.7*

* refers to the respective chapter number in the OGR

Gastrointestinal tract

Overall, 8 recommendations related to inappropriate MR imaging of the gastrointestinal tract, including the screening for colorectal cancer, were identified (Table 8-8).

No overlaps between the programmes were identified. CT is described as being preferred to MRI for diagnosing appendicitis in pregnant women with fever and leucocytosis (for the Austrian context, radiation protection issues need to be considered – the OGR advises CT in the 2nd and 3rd trimester if MRI is unavailable) whereas CTC is described as the appropriate procedure for colorectal cancer screening following an incomplete optical colonoscopy.

Related recommendations in the OGR were identified for three clinical conditions. A direct comparison, due to recommendations being on the same level and relating to the same intervention and patient group, was possible for the following two conditions.

Matching recommendations (Table 4.2-12):

- ❖ For acute abdominal pain, the ACR AC advises against MRI with contrast in pregnant women. The method is, however, suggested when no contrast agent is administered. According to the OGR, MRI is an appropriate follow-up method for ‘acute abdomen’ in pregnant women. Again, no differentiation is made according to contrast agent administration.
- ❖ For suspected appendicitis in pregnant women, MRI abdomen and pelvis with contrast in pregnant women with fever and leucocytosis is not indicated according to the ACR AC. MRI examinations without contrast are, however, rated appropriate following ultrasound. In the OGR, too, MRI is described as suitable follow-up method.

8 Empfehlungen

CT wird für
2 Krankheitsbilder als
bevorzugt beschrieben

3 Empfehlungen haben
Entsprechungen in der
Orientierungshilfe
Radiologie

akutes Abdomen

Appendizitis

Table 4.2-12: MRI – Gastrointestinal tract: Recommendations matching with OGR

Indication	MEL Code	Recommendation/Programme	Orientation Guide Radiology
Abdominal pain, acute	ZCo30	<p>ACR AC: Acute non-localized abdominal pain and fever or suspected abdominal abscess: MRI abdomen and pelvis with contrast in pregnant women; rated 2</p> <p><i>Comment: Because it is unclear how gadolinium-based contrast agents will affect the foetus, they should be administered only with extreme caution; only recommended during pregnancy when there are no alternatives and benefit outweighs risk.</i></p> <p><i>MRI without contrast is indicated.</i></p>	MRI indicated as follow-up for 'acute abdomen'. J.5*
Right lower quadrant abdomen pain	ZCo30	<p>ACR AC: Right lower quadrant abdomen pain- suspected appendicitis: MRI abdomen and pelvis with contrast in pregnant women with fever and leucocytosis; rated 2</p> <p><i>Comment: In general, CT is the most accurate imaging study for evaluating suspected appendicitis and alternative etiologies of RLQ abdominal pain.</i></p> <p><i>MRI without contrast indicated following ultrasound.</i></p>	MRI indicated as follow-up for appendicitis. J.2*

* refers to the respective chapter number in the OGR

Genito-urinary system

50 Empfehlungen
 mehr als 30 % zu
 onkologischen
 Krankheitsbildern

Overall, 50 recommendations related to inappropriate MR imaging of the genito-urinary system were identified (Table 8-9). More than 30% of recommendations relate to oncologic conditions.

Overlaps between the programmes were identified only for the diagnosis of lower urinary tract symptoms with suspicion of benign prostatic hyper-plasia. For initial diagnosis of lower urinary tract trauma and hematuria in children, the preference of CT was described. For the surveillance of prostate cancer, MRI is becoming useful in special circumstances to evaluate for intra-prostatic, local and distant recurrence.

28 Empfehlungen haben
 Entsprechungen in der
 Orientierungshilfe
 Radiologie

For 28 clinical conditions, a related recommendation in the OGR was identified. A direct comparison, due to recommendations being on the same level and relating to the same intervention and patient group, was possible for the following conditions.

Matching recommendations (Table 4.2-13):

unbestimmte
 Veränderung der Niere

✦ In patients with indeterminate renal mass and normal renal function, MRI without contrast is, according to the ACR AC, not indicated whereas MRI with contrast is. In patients with renal insufficiency, however, MRI with contrast is inappropriate because this condition is a contra-indication to intravenous contrast. According to the OGR, MRI is indicated for initially diagnosing renal masses and following up on renal insufficiency (without administering contrast agents).

Ovarialkarzinom

✦ NICE advises against routinely using MRI for assessing women with suspected ovarian cancer. In the OGR, too, MRI is only recommended for problem solving when sonography is unclear.

Inkontinenz bei Frauen

✦ According to NICE, MRI is not appropriate to routinely assess women with urinary incontinence. The OGR also suggests to use MRI for follow-up only.

- ✱ Both the ACR AC and the OGR advise against the use of MRI for initially diagnosing abnormal postmenopausal vaginal bleeding.
- ✱ For diagnosing urinary tract infection in children, routine imaging is not recommended according to NICE. In the OGR, too, MRI is rated no routine indication and only suggested when complications occur.
- ✱ For pre-treatment staging of invasive bladder cancer, the ACR AC suggest to avoid MRI of the abdomen without contrast. However, MRI with contrast and MRI of the pelvis are rated appropriate. According to the OGR, MRI is indicated as follow-up method for pre-treatment staging.

post- menopausale
Blutungen

Harnwegsinfektion
bei Kindern

Blasenkarzinom

Table 4.2-13: MRI – Genito-urinary system: Recommendations matching with OGR

Indication	MEL Code	Recommendation/Programme	Orientation Guide Radiology
Indeterminate renal mass, normal renal function	ZCo30	ACR AC: Indeterminate renal mass: MRI abdomen without contrast for patients with normal renal function; rated 3 <i>Comment: MRI with contrast indicated.</i>	MRI indicated as initial diagnosis for renal mass. L.16*
Indeterminate renal mass, renal insufficiency	ZCo30	ACR AC: Indeterminate renal mass: MRI abdomen with contrast for patients for patients with renal insufficiency; rated 3 <i>Comment: MRI without contrast indicated as clinical condition is a contraindication to intravenous contrast.</i>	MRI indicated as initial diagnosis for renal mass, as follow-up for renal insufficiency (no contrast). L.16, H.7*
Ovarian cancer, suspected	ZCo30	NICE DB: Do not use Magnetic Resonance Imaging (MRI) routinely for assessing women with suspected ovarian cancer.	MRI indicated as initial diagnosis when US is unclear and CT not possible/contraindicated. L.20, H.31*
Urinary incontinence in women	ZCo30	NICE DB: Do not use imaging (MRI, CT, X-ray) for the routine assessment of women with urinary incontinence.	MRI indicated as follow-up. H.34*
Vaginal bleeding in postmenopausal women	ZCo30	ACR AC: Abnormal vaginal bleeding: MRI pelvis without (rated 1) and with (rated 2) contrast as first study of postmenopausal bleeding or endometrium < 5mm by ultrasound.	MRI indicated as follow-up for post-menopausal bleeding. H.29*
Urinary tract infection in children	ZCo30	NICE DB: The routine use of imaging in the localisation of a urinary tract infection (UTI) is not recommended.	MRI no routine indication. K.48*
Bladder cancer, invasive	ZCo30	ACR AC: Pre-treatment staging of invasive bladder cancer: MRI abdomen without contrast; rated 3 <i>Comment: MRI with contrast is indicated. MRI pelvis without and with contrast indicated.</i>	MRI not indicated for diagnosis but indicated as follow-up for staging bladder cancer. L.17*

* refers to the respective chapter number in the OGR

Differing recommendations (Table 4.2-14):

- ✱ In the ACR AC, MRI abdomen with contrast is rated inappropriate for initially diagnosing or following up on incidentally discovered adrenal masses (1-4cm diameter) in patients with no history of malignancy. However, MRI without contrast is indicated. For masses >4cm, the recommendation is the opposite. According to the OGR, MRI is indicated as initial diagnostic method for the characterisation of incidentally discovered adrenal masses.

Raumforderungen
der Nebennieren

Raumforderungen der Nebennieren	✳ According to the ACR AC, incidentally discovered adrenal masses in patients with history of malignancy should not initially be diagnosed with MRI with contrast if the mass is <4cm. MRI without contrast is, however, indicated. If the mass is >4cm, MRI is neither indicated with nor without contrast. According to the OGR, MRI is indicated as initial diagnostic method for the characterisation of incidentally discovered adrenal masses.
Bluthochdruck	✳ For diagnosing medication-responsive hypertension without an evidence of renal disease, imaging is not indicated according to the CAR. In the OGR, however, MRA is rated as method of choice for this condition. The lack of a definition of what ‘renal disease’ means in this context may be a potential reason for differing recommendations.

Table 4.2-14: MRI – Genito-urinary system: Recommendations differing from OGR

Indication	MEL Code	Recommendation/Programme	Orientation Guide Radiology
Adrenal mass, incidentally discovered	ZC030	ACR AC: Incidentally discovered adrenal mass: MRI abdomen with contrast for patients with no history of malignancy, initial evaluation or follow-up, 1-4cm diameter; rated 2/1 <i>Comment: Also applies for follow-up. MRI without contrast is indicated.</i>	MRI indicated as initial diagnosis. H.1*
Adrenal mass, incidentally discovered	ZC030	ACR AC: Incidentally discovered adrenal mass: MRI abdomen without contrast for patients with no history of malignancy, mass >4cm diameter; rated 1 <i>Comment: MRI with contrast is indicated as part of pre-operative staging.</i>	MRI indicated as initial diagnosis. H.1*
Adrenal mass, incidentally discovered	ZC030	ACR AC: Incidentally discovered adrenal mass: MRI abdomen with contrast for patients with history of malignancy, initial evaluation, <4cm diameter; rated 1 <i>Comment: MRI without contrast indicated.</i>	MRI indicated as initial diagnosis. H.1*
Adrenal mass, incidentally discovered	ZC030	ACR AC: Incidentally discovered adrenal mass: MRI abdomen without and with contrast for patients with history of malignancy, mass >4cm diameter; rated 1	MRI indicated as initial diagnosis. H.1*
Hypertension	ZC030	CAR: Hypertension without evidence of renal disease, responsive to medication: all imaging not indicated. Imaging is not indicated if there is no evidence of renal disease.	MRA indicated as initial diagnosis for hypertension without renal disease. H.3*

* refers to the respective chapter number in the OGR

Mamma

11 Empfehlungen	Overall, 11 recommendations related to inappropriate MR imaging of the breast were identified (Table 8-10). All relate to oncologic conditions. Overlaps between the programmes were identified only for the follow-up of ductal carcinoma in situ.
10 Empfehlungen haben Entsprechungen in der Orientierungshilfe Radiologie	Related OGR recommendations were identified for 10 clinical conditions. A direct comparison, due to recommendations being on the same level and relating to the same intervention and patient group, was possible for the following conditions.

Matching recommendations (Table 4.2-15):

- ❖ The ACR AC advise against the use of MRI in the initial diagnosis of both non-palpable and palpable mammographic findings. In the OGR, too, MRI is indicated as follow-up and for staging after mammography and ultrasound have been performed.
- ❖ To rule out local recurrence and distant metastases in asymptomatic women with stage I breast cancer, the ACR AC rates MRI an inappropriate method except for ruling out local recurrence in selected patients (with contrast). According to the OGR, MRI is indicated as follow-up in asymptomatic women >40 after mammography and ultrasound have been performed.
- ❖ For breast cancer screening in average risk women without dense breasts, the ACR AC advise against the use of MRI. According to the OGR, too, MRI is only indicated as follow-up method after mammography and ultrasound.
- ❖ In women aged 50 years and over without a TP53 mutation, NICE advises against MRI breast cancer surveillance unless mammography has shown a dense breast pattern. According to the OGR, MRI is indicated as follow-up diagnostic method if mammography and ultrasound do not yield conclusive findings. For dense breasts, the OGR suggests an ultrasound examination, however.

Mammakarzinom**Fernmetastasen****Screening****Frauen
über 50 Jahren**

Table 4.2-15: MRI – Mamma: Recommendations matching with OGR

Indication	MEL Code	Recommendation/Programme	Orientation Guide Radiology
Non-palpable mammographic findings	ZBo40	ACR AC: Non-palpable Mammographic Findings (Excluding Calcifications): MRI breast without and with contrast; rated 1	MRI indicated as follow-up and for staging after mammography. L.23/1.7, I.11*
Palpable breast masses	ZBo40	ACR AC: Palpable Breast Masses: MRI breast without (rated 1) and with contrast (rated 2)	MRI indicated as follow-up and for staging after mammography and US. I.7, I.11*
Stage I Breast Cancer in asymptomatic women	ZBo40	ACR AC: Stage I Breast Cancer: Initial workup and surveillance for local recurrence and distant metastases in asymptomatic women: MRI breast without contrast bilateral to rule out local recurrence; rated 1 Stage I Breast Cancer: Initial workup and surveillance for local recurrence and distant metastases in asymptomatic women: MRI abdomen without and with contrast to rule out metastases; rated 2 <i>Comment: Also applies for surveillance for local recurrence and distant metastases. With contrast: MRI breast rated 5</i>	MRI indicated for follow-up after mammography and US in women >40. I.3-5*
Breast cancer in average-risk women	ZBo40	ACR AC: Breast cancer screening: MRI breast without and with contrast for average-risk women, breasts not dense; rated 3	MRI indicated as follow-up after mammography, US. I.3-5*
Breast cancer: women aged 50 years and over	ZBo40	NICE DB: Do not offer MRI surveillance to any women aged 50 years and over without a TP53 mutation unless mammography has shown a dense breast pattern.	MRI indicated as follow-up when mammography and US are non-conclusive. US recommended for dense breast. I.4/5*

* refers to the respective chapter number in the OGR

4.2.4 Summary of findings

<p>insgesamt 253 Empfehlungen gegen MRT-Einsatz</p>	<ul style="list-style-type: none"> ✦ The analysis of programmes and databases aiming at promoting an appropriate use of health technologies and interventions, focusing on MRI, yielded a considerable number of recommendations (253) against the use of MRI throughout various clinical conditions. The ACR Appropriateness Criteria® include the most comprehensive collection of clinical conditions and related recommendations compared to the other analysed programs.
<p>21 % beziehen sich auf Kopfuntersuchungen</p>	<ul style="list-style-type: none"> ✦ Most identified recommendations against the use of MRI (53/253; 21%) concern MRI examinations of the head (including brain/cranium).
<p>69 % beziehen sich auf Erstdiagnose</p>	<ul style="list-style-type: none"> ✦ The analysis shows that most (69%) of the recommendations against the use of MRI advise against using MRI as first (initial) examination (e.g., prior to ultrasound or radiographs).
<p>27 % beschreiben onkologische Krankheitsbilder nur wenige Überschneidungen</p>	<ul style="list-style-type: none"> ✦ Oncology is the medical field the majority of recommendations against the use of MRI refer to (67/253; 27%). ✦ Due to differences in the quantity of recommendations and the level of description of clinical conditions, the amount of overlapping recommendations is low (13 overlaps). The highest degree of agreement was reached for the diagnosis of low back pain with no red flags present. The Orientation Guideline Radiology, too, advises against imaging within the first 4-6 weeks.
<p>die analysierten Empfehlungen stimmen zum Großteil mit der Orientierungshilfe Radiologie überein</p>	<ul style="list-style-type: none"> ✦ Where a direct comparison was possible, the recommendations of the Orientation Guideline Radiology and the recommendations of analysed programmes and databases matched in large part. Reasons for differing recommendations may include the aim and methods of recommendation development, controversial evidence, varying assessment criteria and the level of detail in the description of clinical conditions and interventions.
<p>einige Limitationen bestehen</p>	<p>Several limitations have to be mentioned: As the review of recommendations is based on an unsystematic hand search, there may be some further programmes that have not been identified and have therefore not been included in this review.</p>
<p>nur öffentlich zugängliche Empfehlungen</p>	<p>Only publicly available recommendations against the use of MRI have been included. There are, however, programmes (e.g., the Royal College of Radiologists Referral Guidelines) that are not open to the public but restricted to members or paying customers and that were, therefore, excluded.</p>
<p>nicht alle Empfehlungen werden regelmäßig aktualisiert</p>	<p>The ACR AC is the only program that guarantees biennial review and up-date of its recommendation tables, NICE recommendations and the ACCF AUC are updated following the update of guidelines they are based on. However, for the CAR Referral Guidelines, Choosing Wisely® and Choosing Wisely Canada, no such information is available. Due to fast technical changes, recommendations may therefore be based on already outdated evidence.</p>
<p>nicht-standardisierte Methoden</p>	<p>Not all programs use standardised, transparent methods for evidence review and compilation of recommendations. As Choosing Wisely® and Choosing Wisely Canada are carried out by various medical societies, applied methods and criteria are quite heterogeneous.</p>
<p>die Empfehlungen stellen nur eine Auswahl dar und sind nicht vollständig</p>	<p>Especially for Choosing Wisely® USA and Choosing Wisely Canada, the published recommendations only represent a selection (the ‘top 5’) of procedures that were identified to be inappropriate in the respective medical spe-</p>

cialty. Thus, inappropriate procedures that have not been prioritised by the specialty societies are not translated into a recommendation and are therefore not published at all. Presumably, more than 5 recommendations regarding the inappropriate use of MRI could be suggested by the societies.

The overrepresentation of American programmes can be determined a limitation; however, it may be due to the fact that the extent of reaction to problematic overuse and overdiagnosis in health care is higher in the American systems than it is in Europe (yet). In addition, it seems that American programs emphasise the broad dissemination of recommendations, making them publicly available and easily searchable.

**US-amerikanische
Empfehlungen
überwiegen**

4.3 Interventions for reducing inappropriate use of imaging

4.3.1 Results from literature review

Evidence-based clinical guidelines define whether or not imaging is appropriate for a specific clinical condition. Several factors may contribute to an incomplete implementation of these practice guidelines, leading to overuse or underuse of imaging [88-90]

**Faktoren, die zu
unangemessener
Verwendung führen
können**

Factors on physician side identified were:

- ✿ a culture of thoroughness rather than prudence,
- ✿ misaligned incentives under fee-for-service payment,
- ✿ physician-directed marketing, and
- ✿ defensive medicine.

Patient-driven factors were:

- ✿ a preference for high technology,
- ✿ direct-to-consumer marketing, and
- ✿ unawareness from the true costs of care due to third-party payment.

According to a survey amongst radiologists, the perceived causes for increased use of advanced medical imaging were increased possibilities due to new radiology technology, people's increased demands for a certain knowledge about own health, referring physician's low tolerance for uncertainty; expanded clinical indications for radiology, increased availability of radiological equipment and personnel. Perceived causes of unnecessary investigations are over-investigation and insufficient clinical information and unclear questions in the referral [90].

Many different interventions can be used to improve appropriate use of imaging: following the taxonomy of the Cochrane Effective Practice and Organisation of Care (EPOC) group they can be differentiated in educational, financial, organisational and regulatory interventions, which are further distinguished according to whether patients or providers are the targets of the intervention [91]. In the following we present the results of a literature review to identify proposed interventions to reduce inappropriate imaging by MRI and studies on their impact on appropriateness of imaging utilisation.

**Kategorien für
Interventionen zur
Steigerung
angemessener MRT
Verwendung:
edukative, finanzielle,
organisatorische und
regulatorische
Interventionen**

Educational interventions

Table 4.3-1: EPOC taxonomy adapted to educational interventions to reduce inappropriate imaging

Distribution of educational materials	Distribution of published or printed recommendations for clinical care, including clinical practice guidelines, audio-visual materials and electronic publications. The materials may have been delivered personally or through mass mailings. For referrers: Referral guidelines, diagnostic algorithms and evidence-based decision rules, clinical pathways, diagnostic pathways, clinical prediction rules. For patients: Support for informed decision-making (resource cards), information on „incidental findings“, benefit risk information, information on imaging guidelines and actual utilisation data of respective hospital
Educational meetings	Health care providers who have participated in conferences, lectures, workshops or traineeships.
Local consensus processes	Inclusion of participating providers in discussion to ensure that they agreed that the chosen clinical problem was important and the approach to managing the problem was appropriate. E.g. interactions with colleagues to draft standard diagnostic algorithms for common clinical presentations
Educational outreach visits	Use of a trained person who met with providers in their practice settings to give information with the intent of changing the provider’s practice. The information given may have included feedback on the performance of the providers. E.g. radiologist-led educational sessions for referrers
Local opinion leaders	Use of providers nominated by their colleagues as ‘educationally influential’. The investigators must have explicitly stated that their colleagues identified the opinion leaders.
Reminders	Patient or encounter specific information, provided verbally, on paper or on a computer screen, which is designed or intended to prompt a health professional to recall information. This would usually be encountered through their general education; in the medical records or through interactions with peers, and so remind them to perform or avoid some action to aid individual patient care. E.g. Computer aided decision support tools
Marketing	Use of personal interviewing, group discussion (‘focus groups’), or a survey of targeted providers to identify barriers to change and subsequent design of an intervention that addresses identified barriers.
Mass media	Varied use of communication that reached great numbers of people including television, radio, newspapers, posters, leaflets, and booklets, alone or in conjunction with other interventions; ii targeted at the population level.

Referral guidelines implementation

ungenügendes Wissen und Training der ZuweiserInnen wesentlicher Faktor: Zuweisungsrichtlinien müssen erstellt und implementiert werden

Technological advances and expanded medical possibilities are considered the most important factor in the rise of imaging utilisation: imaging studies replace other examinations, sometimes more invasive and expensive [62, 90]. The rapid technical developments and the expansion of indications for MRI make it increasingly difficult for healthcare professionals to stay up to date with current scientific knowledge: a development that has been described as „knowledge crisis“ [92]. Lack of knowledge and/or training has been identified as a major factor leading to inappropriate use of imaging [93]. The availability of referral guidelines, however, is not in itself sufficient to drive appropriate use of medical imaging [94], but need to be complemented by measures to reinforce the use of guidelines [95]. Barriers to the adoption of guidelines are an incomplete dissemination in the medical community, which can be targeted by educational interventions, as listed in Table 4.3-1. Abramson *et al.* list these interventions in the category of „prospective utilisation management“: it includes the drafting of standard diagnostic algorithms for common clinical presentations as well as radiology-led educational sessions with referring providers [61].

The results of RCTs studying the effects of educational interventions on guideline implementation show mixed effects. In a systematic review, French *et al.* reviewed interventions designed to improve appropriate use of imaging for musculoskeletal interventions [96]. Outcome measures included provider performance, such as number of people referred to imaging or clinical outcomes as primary outcomes, depending on the research question the objective could be an increase or a decrease in imaging referral. Three of the included studies analysed MRI: Robling 2002 (knee or lumbar problems, knee and lumbar MRI) [97], Rossignol 2000 (low back pain, MRI) [98] and Schectman 2003 (acute low back pain, lumbar MRI) [99]. Rossignol *et al.* report that practices using a concerted educational programme on clinical practice guidelines (<http://www.core-che.com>) lead to improved health outcomes and reduced unnecessary imaging [97]. Robling 2002, in contrast, report that seminars and feedback are not more effective in increasing appropriate imaging than distribution of guidelines alone [98]. Schectman *et al.* finally report that guideline-consistent behaviour was increased following an education/audit/feedback model with local peer opinion leaders [99].

On European level, a number of initiatives on radiology training exist, such as the European Medical ALARA Network (EMAN) and Medical Radiation Protection in Education and Training (MEDRAPET, www.medrapet.eu). These initiatives have a strong focus on radiation protection, but might provide starting points to promote appropriate use. An EC Tender project under the lead of the European Society of Radiology (ESR) has surveyed the availability and use of referral guidelines in EU Member States and issued recommendations for national and community actions for guideline implementation. These recommendations included lifelong learning (continuing professional development) for referrers, clearer and stronger European measures to encourage both availability and use of referral guidelines and the development and integration of clinical decision support systems (CDS). These should interface with existing electronic requesting systems (computerised physician order entry system, CPOE) and radiology information systems [100].

In Austria, the „Arbeitsgruppe, Orientierungshilfe Radiologie‘ der Bundesfachgruppe Radiologie der Österreichischen Ärztekammer und der Österreichischen Röntgengesellschaft“ has developed referral guidelines for MRI (and CT), which are available online (<http://orientierungshilfe.vbdo.at/>) and are also distributed in printed version. The „Orientierungshilfe“ ranks the evidence based on the Levels of Evidence for Primary research question, adopted by the North American Spine Society, where the highest evidence level for diagnostic studies is provided by diagnostic studies with consecutive patient cohort and universally applied reference „gold“ standard (or systematic review of such studies) [101]. Another project „EBM Guidelines für Allgemeinmedizin“ (<http://www.ebm-guidelines.at/>) develops guidelines for general practitioners, based on the best available evidence. For imaging, this best available evidence is often expert consensus. We did not identify any projects in Austria aiming at increasing the awareness of recommendations against the use of advanced imaging.

Interventionen zur Implementierung von Zuweisungsrichtlinien unterschiedlich effektiv

mehrere europäische Initiativen für Radiologietraining

in Österreich: „Orientierungshilfe Radiologie“

Entscheidungsunterstützung: klinische Pfade

Decision support tools

Imaging is most often part of a clinical pathway for clinical conditions and diseases. There is increasing need for advanced systems to help clinicians to navigate through complex and evolving pathways.

Clinical pathways differ from practice guidelines, protocols and algorithms as they are utilised by a multidisciplinary team and have a focus on the quality and co-ordination of care [102]. Several national quality improvement initiatives have developed such clinical pathways for a vast range of different conditions; others – individual care institutions and hospitals – only for a few high volume interventions [103]. General clinical pathways including the diagnostic work-up for multiple conditions and diseases in high volume and high cost diagnosis-related groups (DRG) (*e.g.* orthopaedics, surgery) are to be found at (examples, not comprehensive):

NICE/GB: <http://pathways.nice.org.uk/>

Queensland Health/AU:
<http://www.health.qld.gov.au/caru/pathways/pathways.asp>

Diagnostische Pfade: Algorithmen für bildgebende Verfahren

Diagnostic pathways (as subset of clinical pathways) have become an important management concept in recent years [104] with the introduction of algorithms for stepped utilisation of highly specialised and costly (laboratory and radiologic) diagnostic tests [105-110]. Diagnostic pathways can be found for example at:

DoH/Western Australia/AU:
<http://www.imagingpathways.health.wa.gov.au/index.php/imaging-pathways>, 12 fields of medical specialities with 10-20 sub-indications each (about 150 to 200 imaging pathways) – Table 4.3-1 as example for pathway for adult head Injury patients.

UpToDate® (fee-based):
<http://www.uptodate.com/>, Evidence based diagnostic algorithms for multiple indications – Figure 4.3-2 as example for diagnostic algorithm for low back pain patients

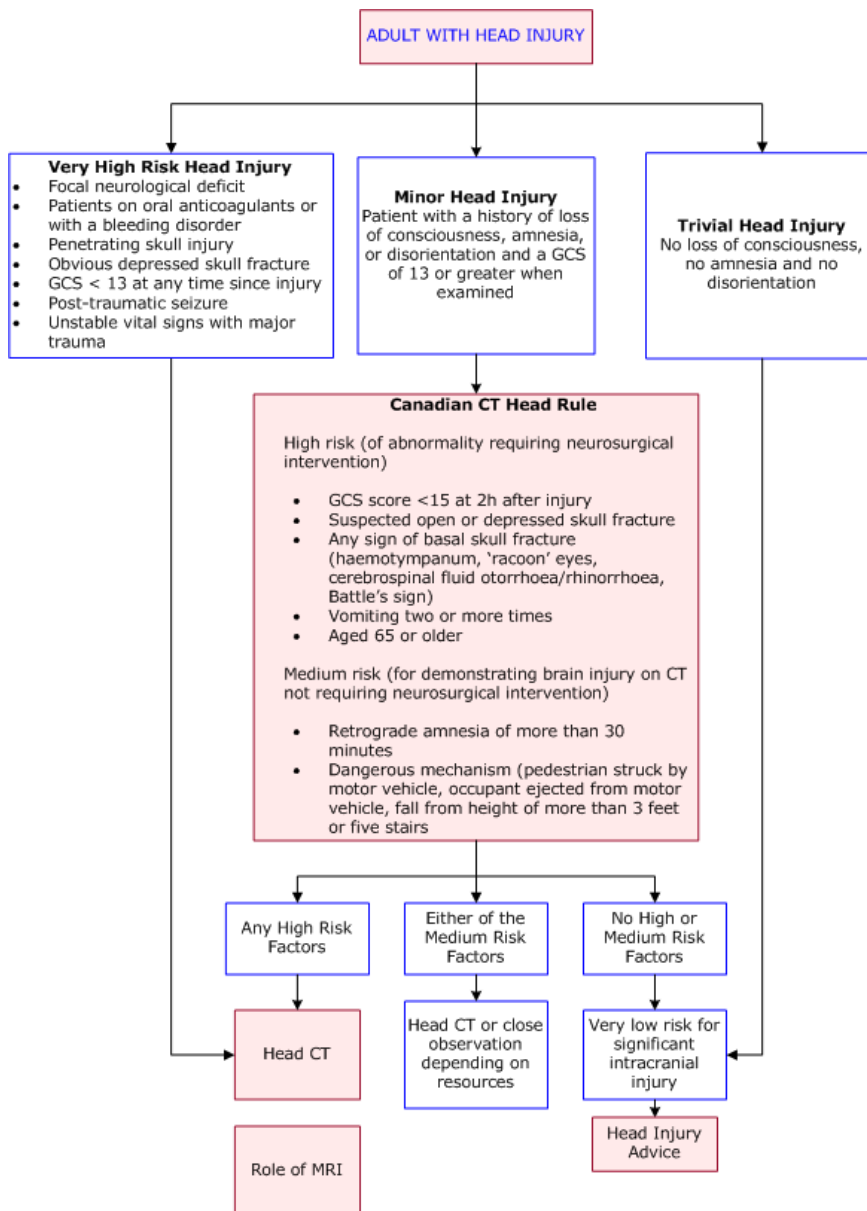


Figure 4.3-1: Pathway for adult head injury patients
 (Source: <http://www.imagingpathways.health.wa.gov.au/index.php/imaging-pathways>)

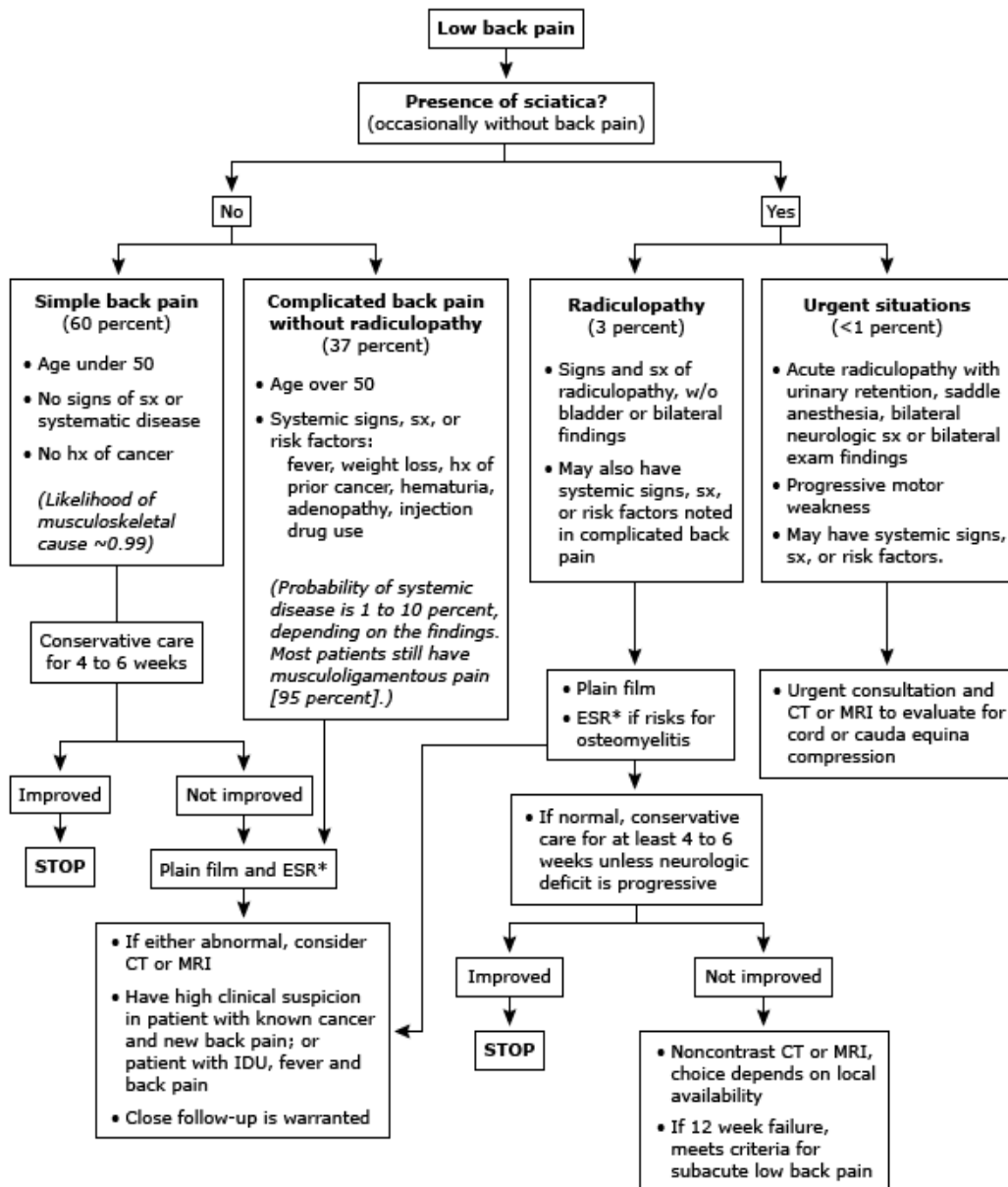


Figure 4.3-2: Diagnostic algorithm for low back pain patients (Source: www.uptodate.com)

**elektronische/online
Entscheidungsunter-
stützung**

Several academic and commercial providers offer online decision support systems that can be integrated with computerised provider order entry, in order to promote the dissemination of established appropriateness criteria and clinical decision rules [111]. This might be purely educative methods of utilisation management on an individual case basis, but could also enable monitoring or even regulation of ordering behaviour. In Australia, a suite of Diagnostic imaging pathways [112] was developed both as a decision support tool and educational tool and disseminated with a multi-faceted approach, with reportedly positive impact on ordering behaviour and general knowledge of diagnostic imaging [111, 113, 114].

Table 4.3-2: Benefits and potential problems/barriers in the introduction of pathways [104, 110]

Benefits	Potential problems and barriers
<ul style="list-style-type: none"> ✦ Support the introduction of evidence-based medicine and use of clinical guidelines ✦ Provide and disseminate explicit and well-defined standards for care ✦ Support continuity and co-ordination of care across different clinical disciplines and sectors ✦ Help reduce variations in patient care (by promoting standardisation) ✦ Support clinical effectiveness, risk management and clinical audit ✦ Improve multidisciplinary communication, teamwork and care planning and between different care sectors ✦ Optimise the management of resources: Expected to help reduce costs ✦ Support training and ensure quality of care with providing a means of continuous quality improvement ✦ Support the implementation of continuous clinical audit in clinical practice ✦ Not prescriptive: don't override clinical judgement 	<ul style="list-style-type: none"> ✦ May appear to discourage personalised care ✦ Risk increasing litigation ✦ Don't respond well to unexpected changes in a patient's condition ✦ Suit standard conditions better than unusual or unpredictable ones ✦ Require commitment from staff and establishment of an adequate organisational structure ✦ Problems of introduction of new technology ✦ May take time to be accepted in the workplace ✦ Need to ensure variance and outcomes are properly recorded, audited and acted upon

In the Manitoba demonstration project, the guidelines in the decision support suggested that more than 10% of imaging orders were inappropriate, but the impact on ordering behaviour was very small [115]. Prerequisites for a successful introduction of such tools are that they should not disrupt patient care workflow and the acceptance of the underlying guidelines [62]. Whether the impact on time to order was positive or negative was depending on the setting [115]. Another study showed good acceptance and support in a family practice clinic, but only 25% of the participants followed advice following prompts of inappropriateness [116]. One retrospective cohort evaluation of the effect of the implementation of an imaging management programme on lumbar MRI, head MRI and sinus CT – three high volume, high cost, high variability procedures – found that the utilisation decreased by 23,4% for low-back pain lumbar MRI, 23, 2% for headache head MRI and 26,8% for sinusitis after the introduction of the decision support based on evidence based decision rules for appropriate imaging. In this setting, providers not documenting compliance with guidelines were denied MRI [117].

Other studies reported the reduction of high-cost imaging, but without data on appropriateness in outpatient setting [118] or hospital setting [119], good acceptance and reduction in low utility examinations [120], reduction in CT, but only small reductions in MRI [121, 122], decreases in low yield imaging procedures [123, 124].

Decision making tools may also designate clinical prediction rules, such as the Ottawa Ankle Rule: this clinical prediction rule identifies patients at such low probability of fracture that imaging is not necessary. A useful clinical prediction rule is clinically important, it must make sense to users, be reproducible and easy to use, clinically relevant and validated [125]. They fulfil different purposes such as exclusion criteria in emergency settings, or a cost-effectiveness analysis to determine the most appropriate imaging modality. A framework for the development of decision support applications for acute low back pain was presented by [126]. A group in Ottawa has developed 4 decision rules for the use of imaging in trauma cases: the Ottawa Ankle Rule,

**elektronische
Entscheidungs-
unterstützung:
unterschiedlich effektiv**

**Entscheidungs-
unterstützung:
klinische
Prädiktionsregeln**

the Ottawa Knee Rule, the Canadian C-Spine Rule, and the Canadian CT Head Rule. Application of these decision rules has resulted in a 20%-30% reduction in imaging [127].

**Pilotprojekt:
Altarum Institute, USA**

The Altarum institute (USA) is leading a community based intervention to reduce unnecessary imaging studies by establishing a data-exchange and decision support system complemented with training of a network of area care providers.

Patient demand

**Nachfrage durch
PatientInnen als Treiber
steigender Verwendung**

According to a survey amongst radiologists in Norway, the perceived major cause of unnecessary radiological investigations are increased supply and demand of services [90]. In a cross-sectional survey amongst elderly patients in the US, a correlation between the perceived need for radiological studies and imaging utilisation was found [128]. A survey amongst patients with early stage breast cancer showed that patients want imaging done, even if the chance of detecting metastases was <10% and that they would feel uncomfortable if imaging was not ordered, even if this was in line with guidelines [129]. Patients are increasingly aware and concerned about their health status and less willing to accept *e.g.* ageing issues as a normal status. Patients are reported to be better aware of their rights as patients and to appear increasingly demanding [130]. Increased patient demand is also assumed to be related to the „health culture“, the public opinion on the practice of medicine, with an increased call for prevention and strong industry influence, potentially leading to misguided patient preferences.

**Furcht vor Klagen,
defensive Medizin**

As a consequence health care providers have increasing concerns for medical-legal risk (fear of litigation), promoting defensive medicine and imaging with no clinical rationale, other than to rule out pathology [90]. Patient satisfaction, however, does not equate to health outcomes and increased utilisation and increased expectations go hand in hand [131]. Moreover, defensive medicine may produce VOMIT („Victims of modern imaging technology“) [132] through incidental findings, due to the statistics of multiple testing and the bias introduced by medical history (incidental findings will be used to explain symptoms) [133].

**nationale
Aufklärungskampagnen
und Infokarten für
das ärztliche Gespräch
als Steuerungselemente**

Nationwide efforts may be effective to discourage inappropriate medical imaging: for example the distribution of hospital-level utilisation data together with the latest imaging guidelines on prostate cancer imaging was associated with a reduction in inappropriate imaging (from 45% to 3% in the low-risk category) in a 10 year period [134]. Australia developed a resource card for practitioners and their patients providing information to both patients and GPs when discussing diagnostic imaging tests [135]. The resource card includes information for the healthcare professional on his responsibilities as a referrer and on the elements a patient needs to be educated about to make an informed decision: the nature of the imaging procedure, the benefits and risks, alternative forms of investigation that provide the same results, benefits and risks of the alternative investigations, benefits and risks of not undergoing investigation [136]. The patient information on MRI provided by the Austrian Radiology Society could be complemented with these elements [137].

**Pilotprojekt:
PCORI, USA**

A pilot project at the Patient-Centered Outcomes Research Institute (PCORI, USA) aims to develop an educational intervention for primary care physicians based upon simulated office visits with standardised patients and to evaluate the effectiveness and durability of this intervention (Joshua Fenton, personal communication).

Structural and organisational interventions

Table 4.3-3: EPOC taxonomy adapted to structural and organisational interventions to reduce inappropriate imaging

<i>Organisational interventions</i>	
Revision of professional roles	Also known as 'professional substitution', 'boundary encroachment' and includes the shifting of roles among health professionals. Also includes expansion of role to include new tasks. E.g. revision of the roles of general practitioners and radiologists in the
Clinical multidisciplinary teams	Creation of a new team of health professionals of different disciplines or additions of new members to the team who work together to care for patients. E.g. multidisciplinary imaging teams
Communication and case discussion between distant health professionals	Mandatory consultation, voluntary communication
<i>Structural interventions</i>	
Changes in medical records systems	E.g. standardisation of digital referral
Presence and organisation of quality monitoring mechanisms	E.g. Hospital performance benchmarking, Internal and external audit, monitoring of utilisation

Revision of professional roles

Blackmore *et al.* describe two models for the role of radiologists in defining quality in radiology: the first is the „radiologist production model”, the second the „radiologist professional model” [138]. In the radiologist production model radiologists are paid based on the number of imaging procedures carried out: in Austria, current reimbursement is based on this model. The „radiologist professional model” in contrast describes a more extensive role of the radiologist as „experts in the use of imaging for diagnosis, specialists in image acquisitions and interpretation and consultants in the application of imaging information to patient care”, with corresponding quality metrics detailed in [138] and Table 4.3-4.

**RadiologInnen:
neues Rollenverständnis
über Service-provider
hinaus**

Table 4.3-4: Quality metrics – Radiologist professional model [138]

Component of Professional Model	Elements	Sample Metrics
Who should be imaged?	Use of evidence-based imaging practice	Adherence to clinical prediction rules, compliance with local and national practice guidelines
What imaging approach?	Selection of optimal imaging strategy	Diagnostic yield, adherence to clinical prediction rules, compliance with local and national practice guidelines, rate of additional (induced) imaging studies
How are studies interpreted?	Balance of sensitivity and specificity	Rate of false-positive and false-negative diagnoses, diagnostic yield
	Tailoring of interpretation to clinical scenario	Ratios of adverse false-positive outcomes (i.e., negative laparotomy result, negative biopsy result) vs rate of adverse false-negative outcomes (i.e., delayed diagnosis)
Patient outcome	Effect of imaging on patient care	Rates of specific therapeutic interventions after imaging (i.e., use of thrombolytics for non-haemorrhagic stroke, biopsy or appropriate follow-up for lung nodule, repositioning of endotracheal tube after misplacement identified on chest radiograph)
	Effect of imaging on outcome	Rates of specific medical errors after imaging (i.e., negative laparotomy for appendicitis, nontherapeutic knee laparoscopy, intracranial haemorrhage after thrombolytics for stroke)

<p>multidisziplinäre Expertise benötigt, um angemessene Bildgebung zu definieren</p>	<p>One factor supposedly spurring inappropriate imaging is the „knowledge crisis” – the „overload” of physicians with reported technological advances, <i>e.g.</i> at conferences and the difficulty to stay up to date with and analyse the underlying evidence. Deciding on the appropriateness of an imaging request requires the expertise of multiple disciplines, depending on the clinical case.</p>
<p>... im Spital</p>	<p>Fraser <i>et al.</i> propose the creation of joint multi-disciplinary diagnostic services for cardiovascular imaging to coordinate the clinical use of diagnostic imaging technologies in a cardiac hospital unit [139]. The joint service should include cardiologists, radiologists and nuclear medicine specialists. We did not identify any studies analysing the impact of clinical multidisciplinary teams on medical imaging use.</p>
<p>... im niedergelassenen Bereich</p>	<p>In Canada, the Medical imaging team (www.imagingteam.ca) including physicians (radiologist, nuclear medicine specialists), physicists, sonographer and technologists receives every request for medical imaging and assesses the potential benefits and risks of the examination before the examination is booked. This process is carried in 3 steps: review stage, protocol stage, prioritisation stage. In the review stage, the alignment of the request with the patient’s history is reviewed and the most appropriate imaging modality is identified, based on patient’s availability, accessibility, radiation minimisation and (cost-)effectiveness. In the protocol stage, the request becomes a prescription of a certain imaging protocol. In the last stage, the requests are prioritised according to their time-sensitivity [140].</p>
<p>Communication and case discussion between distant health professionals</p>	
<p>Beratung durch RadiologInnen als Steuerungsinstrument im niedergelassenen Bereich:</p>	<p>Early studies did not demonstrate an effect of mandatory inpatient radiology consultation service on resource utilisation and suggested this as a more promising option for the outpatient setting [141].</p>
<p>... über gelegentliche Rückfragen hinausgehend</p>	<p>In the outpatient setting, point-of-care techniques aim to incorporate radiologist consultation in the clinical workflow [61]. The routine reviewing of requests for diagnostic imaging by radiologists could help both the assessment of appropriateness and the interpretation of test results [142]. According to the professional model described by Blackmore 2007 [138], communication between radiologist and ordering physician should go beyond simple callbacks on protocol selection or contra-indications. However, a routine reviewing of imaging requests is time consuming and may take longer than simply to carry out the study – thus implementation will require financial (or regulatory) incentives.</p>
<p>Hotlines</p>	<p>There are several ways to incorporate radiologist consultation in the clinical workflow. It could be a radiologist-staffed hotline for consultation of test ordering [138]. Duszak <i>et al.</i> describe radiology benefits management (RBM) as another option: in the US, these are business models, where health insurers may outsource the management of their imaging portfolios, profitability of the RBM depends on its success in controlling imaging expenditure [143]. RBM may act as pure educational initiatives or have more a more regulatory role with pre-authorisation by a RBM required for the provision of imaging.</p>
<p>„Radiology benefits management”</p>	<p></p>
<p>Netzwerk aus bevorzugten ZuweiserInnen</p>	<p>Another options to improve the case communication between referrer and radiologist is to restrict imaging provision to a list of accepted referrers and to define a mandatory amount of information that needs to be provided with the imaging request [138]. Our literature search did not yield any studies analysing the impact of case discussion on medical imaging use.</p>

Changes in medical records systems

Insufficient referral information was identified as a major factor leading to inappropriate imaging. Information loss between providers was identified as a factor leading to inappropriate imaging [90]. This can be adjusted through communication between radiologists and ordering physicians, but requires the effort of radiologists to collect the missing information. Another solution is to standardise and digitalise referrals in order to ensure completeness of the provided information, including the patient's imaging and clinical history. This requires an appropriate IT infrastructure and the use of electronic health records.

Electronic decision support tools may not necessarily be integrated with electronic health records, but may also be used as stand-alone tools [126, 144]. However the automatic provision of decision support as part of clinician workflow was identified as a critical feature of clinical decision support tools to improve clinical practice [145].

A systematic review of 14 observational studies of the impact of computerized provider order entry (CPOE) on medical-imaging services (with/without decision support), found that „significant imaging-department efficiency and effectiveness gains associated with CPOE may be achieved. Most of these benefits were associated with DSS promoting adherence to test ordering guidelines” [146]. The majority of the studies, however, analysed the impact on general radiology procedures.

After receiving the order by the clinician, radiologists review the order and assign a specific protocol for the examination. This decision step may also be computer-assisted and -recorded to ensure documentation and standardisation. One such tool is the Radiology Protocol Tool Recorder – RAPTOR [147].

Presence and organisation of quality monitoring mechanisms

Abramson *et al.* suggest as „retrospective” measures the profiling and targeted educational interventions aimed at colleagues with outlier ordering patterns [61].

In their report „Referral guidelines for medical imaging – availability and use in the European Union”, the ESR included recommendations for monitoring through clinical audit, preferably through external audit, but also through local internal audit. External audit has been addressed in EC guidelines on clinical audit (EC guidelines on clinical audit for medical radiologic practice), but further measures are needed to promote local internal audit. (ESR referral guidelines for medical imaging – availability and use in the European Union). Standardised documentation and terminology is a prerequisite for any monitoring measure [40].

Quality improvement programmes by monitoring of imaging utilisation were *e.g.* initiated by the Centers for Medicare and Medicaid Services (CMS, US): the Hospital Outpatient Quality Reporting Program (HOQR) is publicly reporting US hospitals' use on imaging studies with potentially problematic overuse, amongst which MRI studies performed for patients with low back pain without antecedent conservative therapy. Data emerging from this monitoring were analysed with regards to the variability of imaging use, with a highly skewed distribution being interpreted as indicative of overuse, as it would be unlikely to be explained by case mix or random chance. The effect of publicly reporting hospital performance was deemed limited by the study authors, as imaging overuse was rarely consistent across indications and pa-

Treiber: ungenügende Informationen in Zuweisung

... Standardisierung und Digitalisierung der Zuweisungen

Integration in elektronische Gesundheitsakte

effektiv in Steuerung angemessener Verwendung

interne oder externe Qualitätskontrolle

benötigt standardisierte Dokumentation

tients often had limited choice of available hospitals in rural areas and hospitals thus would experience little pressure to improve their imaging utilisation [148].

wenn Überverwendung identifiziert: Aufklärung anbieten

Cammisa *et al.* report a quality improvement project, in which actionable areas of overuse were identified from claims data (notably, management of acute and chronic back pain by MRI of the spine during the first 4 to 6 weeks of symptoms in the absence of a prescribed set of „red flags.”) by an expert panel. In outreach visits, primary care physicians were engaged in a „respectful discussion” on the panel’s recommendation, peer comparison data and best practices. Pre-post intervention analysis showed a decrease in the identified overuse areas in the post-intervention time period. However, due to the study design, causality cannot be demonstrated [149].

Regulatory and financial interventions

Table 4.3-5: EPOC Taxonomy adapted to financial and regulatory interventions to reduce inappropriate imaging

<i>Financial – Provider interventions</i>	
Fee-for-service	Provider has been paid for number and type of service delivered
Capitation	Provider was paid a fixed amount per patient for providing specific care. E.g. bundled payment per episode of care, population-based bundling
Pay for performance	
Formulary	Added or removed from reimbursable available products
<i>Financial – Patient interventions</i>	
Co-payment	Patient payment at the time of health care delivery in addition to health insurance
<i>Regulatory interventions</i>	
Pre-authorisation	Requirement for formal approval of a planned imaging procedure from the insurance company or its designee
Pre-notification	Requirement for review of a planned imaging procedure by the insurance company or its designee
Ownership, accreditation, and affiliation status of hospitals and other facilities	E.g. accreditation of imaging facilities, medical equipment planning by health authority

finanzielle Anreize, um evidenzbasierte Versorgung zu belohnen

Economic incentives of the reimbursement system should reward evidence-based care and preferred outcomes [67]. The collection of activities to reduce the high levels of utilisation and spending that come with unfettered fee-for-service is also summarised under the term „managed care” – it encompasses *e.g.* financial incentives to influence utilisation patterns, direct oversight of utilisation decisions, selective contracting with preferred physicians and hospitals or restricted choices through closed panels and gatekeepers [150].

USA: „radiology benefits management” und „accountable care organisations”

In the US, new models for health care delivery using economic incentives to meet quality performance goals have evolved from early managed care organisations (radiology benefits management – RBM) and aim to combine cost containment with quality of care performance goals [61]. These accountable care organisations (ACO) use fee-for-service but also capitated payment structures, such as bundled payments for episodes of care or global (population-based) bundling [61]. The rise of ACO is considered a potential threat to the revenues of radiologists groups, which in turn could incentivise radiologists to take on „a more central role within integrated care entities by developing and deploying systems service lines (...) that may include utilisation management, decision support, quality and safety assurance, and operational enhancements” [61].

A retrospective analysis of medical records on imaging procedures carried out in Turkish hospitals reported that the temporary introduction of a capitated payment scheme, where a fixed amount per outpatient is paid to the hospital according to the discipline, regardless of the number of procedures carried out, led to a reduced imaging demand during this episode [151].

The US health care system and its fee-for-service payment process was described a contributor to overutilization of imaging services in a report of a US Radiologists summit [67]. However, this finding is not easily transferrable to other settings. A review of funding for diagnostic imaging services in Australia comes to the conclusion that „the current (...) fee for service model has worked well to provide reasonable patient access to high quality imaging services (...). Any proposal to shift to alternative funding mechanisms will need careful policy design.” [152].

Any transformation from a fee-for-service model to a pay-for-performance model will require both robust metrics and tools to measure performance and the implementation of instruments for utilisation management [143, 153]. Performance measures proposed are *e.g.* a profiling of physician ordering pattern using decision support systems or radiology benefit managers [143, 153].

**Fee-for-Service als
Treiber unangemessener
Verwendung**

**Umstellung auf
pay-for-performance
benötigt robuste
Maßzahlen**

Financial incentives targeting patients

Shah *et al.* describe the consequences on health services utilisation following the introduction of cost-sharing by coinsurance for (amongst others) imaging services. The results of the cohort study showed that relatively low levels of cost sharing led to a long-term decrease in utilisation, however there was no analysis of the appropriateness of imaging utilisation [154].

Selbstbehalte

Regulatory interventions

Containment of self-referral

Physicians with ownership interests in medical imaging equipment are more likely to use imaging as physicians who referred their patients to radiology, [155-157]. Radiologists have a consultant role in this situation and may actually limit overuse. However, they may also contribute to overuse in situations in which they act as primary care providers and *e.g.* publicly advertise their services [158]. One measure to contain inappropriate imaging by self-referral is the introduction of an accreditation process for facilities furnishing advanced diagnostic procedures [159]. Such an accreditation of imaging facilities and the compliance with quality standards including training of staff, is already a condition for reimbursement in Austria.

**Treiber:
Eigenzuweisung kann
durch Akkreditierung
limitiert werden**

Delisting of medical services

A top-down approach to reduce inappropriate is the delisting of medical imaging services: *e.g.* the Ministry of health in the province of Ontario, Canada has delisted certain lumbar spine studies in the absence of suspected or known pathology [160]. An obligation set out in the April 1, 2012 OHIP Fee Schedule of ordering physicians to repay for CT/MRI studies of the lumbar spine if such service is subsequently determined not to be medically necessary was later revoked [161].

**Streichen von
medizinischen
Leistungen für
Refundierung**

<p>Autorisierung von Zuweisungen als Voraussetzung für Refundierung</p>	<p>Prior authorisation</p> <p>Prior authorisation designates the requirement for formal approval of a planned imaging procedure from the insurance company or its designee (or <i>e.g.</i> a RBM company). In the absence of prior approval, reimbursement of the procedure may be refused [162].</p>
<p>effektiv in Reduktion der Verwendung</p>	<p>The success of prior authorisation in controlling imaging utilisation has been analysed in several studies. For example, Blachar <i>et al.</i> report a reduction of 9% of MRI examinations following the introduction of pre authorisation [162]; similar pre-post introduction case studies showed a decline of utilisation rates by 8% to 15% [163]. The effects flattened out in the second year after introduction [163].</p>
<p>jedoch Verbesserung der Qualität nicht erwiesen</p>	<p>Potential problems associated with prior authorisation are a lack of transparency, the disruption of the clinical work flow and the administrative burden. The impact on quality improvement is not demonstrated [164].</p> <p>A recent study showed that the removal of the denial provision (<i>i.e.</i> refusal of reimbursement) in pre-authorisation did not lead to increased imaging utilisation [165]. Several authors state that the effect of prior authorisation on appropriate utilisation may in large part be attributed to an educational effect on the referrers [62, 164].</p>

Prior notification

Prior notification describes the process of a prior authorisation without denial provision. Prior notification programmes emphasise the educational and collaborative aspect with referring physicians [21].

4.3.2 Results from stakeholder interviews

<p>Interviews mit österr. Stakeholdern zum Abgleich mit dem nationalen Kontext</p>	<p>In this step, we were interested to contrast the results of the literature review with the perspectives of stakeholders in Austria, to identify factors potentially contributing to inappropriate imaging in Austria and the criteria and mechanisms currently in place to minimise it. Furthermore the potential applicability of additional interventions to the Austrian context was investigated.</p>
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Educational interventions-Referrers

<p>ZuweiserInnen, nicht RadiologInnen verantwortlich für angemessene Verwendung</p>	<p>In our interviews, the referrers were identified as being responsible to ensure the appropriateness of their imaging requests. Radiologists both in the inpatient as in the outpatient setting stated, they would refuse imaging if contra-indications are suspected and seek clarification with the referrers, but beyond that no assessment of appropriateness would take place: „Radiologists are not in the position to question every referral”.</p>
<p>Treiber: fehlende Ausbildung und Training</p>	<p>Lack of training and/or experience was mentioned as a factor leading to over-utilisation of MRI: young and poorly trained physicians would be more prone to order imaging for the sake of reassurance and defensive medicine and are less familiar with other diagnostic examination methods. Consequently referrers are primarily targets for educational interventions on appropriate imaging and should be trained to differentiate situations in which imaging is appropriate or not.</p>

Electronic decision support tools were poorly perceived by some: concerns expressed were the „alert fatigue”, the misuse by filling in the information needed for the desired result, the replacement of knowledge and counselling by a programme. Others found it a possible useful solution, if coupled with digitalised ordering systems.

The „Orientierungshilfe Radiologie” was known amongst all our interviewees and was identified as guidance specifically targeting the referrers. In addition, guidelines on contrast agents and lists for acute indications are used. Intramurally, standard operating procedures (SOP) *e.g.* for night shifts are developed, sometimes by an interdisciplinary board. ‘Do not do’ Recommendations were often not known, or not in detail. There were concerns on the applicability to the Austrian context. Due to the lack of direct risks from MRI (as opposed to techniques using ionising radiation), several interviewees expressed the concern, that in clinical practice it is difficult to identify situations in which MRI imaging would clearly not be justified, and refusal would affect the diagnosis by exclusion.

**elektronische
Entscheidungs-
unterstützung
unterschiedlich
bewertet**

**„Orientierungshilfe
Radiologie” als
Zuweisungsrichtlinie
allen
InterviewpartnerInnen
bekannt**

Table 4.3-6: Interview responses: Educational interventions – referrers

Current decision making process in practice

We make an anamnesis prior to each examination. We refuse exams due to implants or other contraindications.

A standardised documentation of refusal justifications is currently a matter of debate.

The radiologist on duty will contact the referrer if he thinks an investigation is not indicated.

No examination without referral.

The radiologist on duty is in charge to refuse MRIs that are not indicated, but this occurs very rarely.

Outpatient radiology institutes are not in the position to question referrals.

The basis of each MRT exam are the clinical examination and the referral.

MRT is often used for diagnosis of exclusion, to rule out severe conditions.

We have no time for unnecessary examinations, we contact the referrer if something needs to be clarified.

If an MRI is requested by a referrer and authorised by the health insurance it is very difficult, as a private institute, to refuse it.

The radiologist is not in the position to control or question a referral, if it is an usual indication.

Referrers as targets for educational interventions

There are deficits in the communication and in the education. It should be communicated that certain methods benefit only a selected patient pool. There is not enough knowledge about diagnostics.

We offer a service hotline for referrers. It is a service, not mandatory.

Physicians with poor training are a problem, as they tend to compensate lack of knowledge by investigations.

The referrer must know whether a MRI is appropriate or not and use criteria for decision making. He is responsible for the ensuing treatment of the patient.

The referrer is in charge [of evaluating appropriateness].

A negative result may be useful, if it allows for example to discharge a patient, sparing the costs for a day at the hospital. But there should be limitations to the use for exclusion of diagnosis.

The referrers need to be trained to follow the guidelines; the radiologist is not in the position to question every referral.

There is also an increased demand from the physician’s side: young practitioners are dependent of high-tech methods, less familiar with other diagnostic methods.

Diagnostic investigations are performed for reassurance.

The referrers are the targets, able to steer appropriate use of MRI.

Deviation from guidelines must be possible *e.g.* depending on local circumstances: available equipment, doctor/patient readiness for watchful waiting, concerns of complications, time pressure.

A desire for reassurance, notably of young physicians, certainly promotes the use of MRI, also because there are increasingly lawsuits.

The referrers are more aware of MRI.

Frequently the examination has no consequences and provides no additional information. The referrers should be aware that MRI is not always the superior method.

The referrers should be in charge [of evaluating appropriateness].

Inadequate education is the problem, insufficient knowledge leads to uncertainty, which is compensated by investigations. It is very difficult to identify the situations in which an examination is necessary.

Decision support tools

Decision support tools are useful, as the referrers have less expertise. The referrals should be digitalised so they can be examined before arrival of the patient.

Decision support tools could be a solution, but there is a lot of suspicion against it: It is a tool, they cannot replace the examination and counselling by a human. A standardisation of the communication would benefit all. It would also help to justify a decision.

There is the problem of „alert fatigue“ with electronic decision support tools, the problem of a feeling of false security, and the danger of distracting from the consultation.

DST are poorly received in practice.

DST are replacing knowledge by a programme.

From the experience with DST for mammography, we see that the tools are filled with the information to get the desired result.

The „Orientierungshilfe Radiologie“ is an educational tool and decision support for referrers.

The „Orientierungshilfe Radiologie“ is a good start, but there might be room for improvement of its user-friendliness as a decision support tool.

We are using the „Orientierungshilfe Radiologie“. There are regular updates and trainings.

We use the „Orientierungshilfe Radiologie“. There are clear acute indications. It is difficult to enforce guidelines without affecting the diagnosis of exclusion. It is not possible to refuse an examination if the [referring] clinical is not confident e.g. that it is safe to discharge a patient.

Guidelines development and implementation

We use international guidelines. Regular continuing training is mandatory.

There is a lack of robust evidence on imaging from trials. Guidance is developed based on the best available evidence, often qualitative decisions.

Disinvestment recommendations are known, but not in detail. There are concerns that they are not applicable to the situation in Austria.

Disinvestment recommendations are not known. Obvious situations in which MRI is not recommended: presence of implants, patients soon after an operation.

The inclusion of new indications in the benefits catalogue is possible only after demonstration of clinical benefit.

Guidelines provide a professional background, they must be adapted to individual situation.

We have a monthly meeting of the interdisciplinary board, where we discuss and agree on guidelines and SOP.

There are no guidelines for pre-authorisation. It is difficult to argue against imaging, no major risks of MRI (except contrast agents).

We follow international guidelines (e.g. ESUR guideline for contrast agents); in addition we have internal SOPs and specific lists e.g. for acute indications during night shift.

Educational interventions-patients

Treiber: Nachfrage durch PatientInnen

An increase in patient demand was also indicated as a factor leading to increased imaging utilisation in our interviews. Patients expect to receive the best available treatment, including high tech methods, driven by a political „promise“ of „elite medicine“ and by mass media driving fear from complications and suspicion against economisation of health services.

Angst vor Klagen

On the radiologist’s side this increases fear of litigation for wrongly refusing or delaying an examination.

Evidence based information is available, but due to literacy barriers are not considered suitable information tools for patients. Rather interviewees identified public campaigns, educational measures targeting the patients and journalists, *e.g.* through key opinion leaders as important measures. These measures should explain negative aspects associated with inappropriate use of diagnostics, such as incidental findings and therapeutic consequences.

Aufklärungskampagnen

The GP with a strong patient relationship could act as a multiplier of such messages. In contrast, radiologists do not consider themselves in the position to directly influence patient preferences, notably as extramural service providers.

Table 4.3-7: Interview responses: Educational interventions: patients and public

Patient demand

As a service provider it is our interest to satisfy our patients. We inform them if examinations are unnecessary, but we do not refuse anything, that could cause conflicts.

The patient has the expectation, that imaging is the best method. If he is not satisfied with the recommendation, he is free to choose another doctor.

Patients inform themselves in the internet and explicitly request MRIs.

Patients claim rightfully to receive the best available treatment, including comprehensive examination.

In Austria there is for many years a political pressure for elite medicine. The population expects that services are available all the time.

Patient demand plays a role – a young athlete might be more impatient, needs a diagnosis to resume his training.

Maybe patients are more responsible, more inquisitive and demanding.

All patients consider themselves as acute cases.

In an unfettered system, patients are able to resort to private medicine if they insist on imaging that their GP would not order. Pressure on patients is exerted via mass media, that increase fear from complications and suspicion towards refusal of procedures. This promotes overuse and pressure on referrers.

Patients believe in a „right to health“ and requests immediate diagnosis. Imaging is ordered to satisfy patients. From the radiologist’s perspective this is difficult to control, he can verify the indication, but not the full anamnesis of the patient.

Defensive medicine

Referring physicians are unwilling to discharge patients without an MRI or to delay a MRI to the next day. The desire for reassurance out of fear of litigation is certainly a reason, because there is an increase in lawsuits.

Out of fear of litigation, guidelines are bended/interpreted until a MRI is indicated.

Notably in acute situations there is a practice of defensive medicine: MRI is used for quick diagnosis to decide for or against admission.

At our hospital there is the „juridical“ indication: the fear to discharge a patient with unspecific symptoms who is diagnosed hours later with a severe condition, issuing a lawsuit for incomplete clarification. This tendency is increasing: there is also a patient advocate.

Educational interventions targeting patient and public

The communication targeting patients is essential. The patients need more transparency. We would need opinion leaders with a message similar to Choosing Wisely, that is targeted to patients, to educate them about diagnostics.

There is no need for steering instruments on the medical side, but rather on the organisational level. The one-sided perception that radiology only increases spending should be avoided, rather this needs an objective appraisal.

There is evidence-based patient information available (*e.g.* TGAM, DEGAM, IQWIG), but many patients are not reached (literacy). We need education about negative aspects, incidental findings and therapeutic consequences.

Qualification trainings for journalists would make sense- these are the ones steering public opinion and are in the position to create pressure.

A sensible public campaign could help: „We are all mortal, we spend too much money for examinations of conditions that will resolve by themselves, one must not always see a doctor.“ to educate patients, promote health literacy, self-responsibility and a awareness of the problem.

I interrogate my patients on their readiness to undergo operation [when requesting an exam]

Patients already receive information of the costs [of their medical services]. In the journals, it is more frequently promoted to get examinations.

It is extremely difficult to explain the patients that [by using unnecessary imaging] they are using up resources from others.

Politicians need to communicate that not every examination makes always sense and also is not always available. The image of a high tech medicine leads to strong patient expectations and in consequence to litigations. Patients need to accept practice according to guidelines.

The readiness of the patients to wait for self-recovery needs to be increased.

Patients are not always responsive to information on appropriateness.

Structural and organisational interventions

Revision of professional roles

**Vorschlag:
HausärztIn als
Weichensteller**

In our interviews, representatives of general practitioners called for a gate-keeper function of the GP: according to their statements, the GP is in a good position to contain diagnostic imaging, due to his/her long-lasting and continuous relationship with the patients. Moreover a central aspect in the practical training of GP is the critical use of diagnostics and use of alternative methods (to imaging). In the outpatient setting, both general practitioners and specialists such as neurologists, orthopaedists are allowed to refer patients to radiologists for MRI scans. For GPs, radiology training is not a mandatory element of medical training. In contrast to Australia, for example, where over 65% of requests for diagnostic imaging are made by general practitioners [60], referrals by general practitioners are rare in comparison to referrals by other specialties in Austria. Our literature search did however not identify any reports on the effect of strengthening the role of general practitioners gatekeeper function on appropriateness of imaging requests.

**RadiologInnen:
derzeit nicht in Position,
Angemessenheit zu
steuern**

Radiologists in our interviews expressed that current patient and work flow does not allow them to ultimately make the decision on whether a certain imaging request is appropriate or not. Notably in the outpatient setting, radiologists perceive themselves as service providers with an interest in customer satisfaction – the „customers” being both the patients and the referrers. There are feedback loops on protocol selection, if there are concerns on the feasibility of an imaging requests, *e.g.* if a patient is referred early after an operation or suspected to carry implants. Beyond these obvious contraindications, radiologists state, an assessment of appropriateness is not feasible due to time constraints, respect towards the referrer and lack of oversight of the patient’s full clinical history.

Communication and case discussion

**Kommunikation
zwischen Zuweisenden
und Radiologie**

Our interview partners explained that communication between referrers and radiologists is common, both in hospital and outpatient setting. This communication is, however usually carried out only in case of ambiguity – from either side – and does not constitute a routine reviewing of imaging requests.

Standardisation of information exchange

**elektronischer
Datenaustausch sinnvoll**

The interviewees generally supported electronic referrals, and stated that electronic referrals improve their completeness and allow a timely review of imaging requests. Standardised referrals are implemented in some departments of some hospitals. In Austria, such a system – ELGA (ELEktronische GesundheitsAkte) – has been deployed in 2014 and will be gradually expanded first

to the Austrian hospitals and as of 2016 in the outpatient sector. An example for an MRI request using ELGA can be found at the ELGA website [166]. ELGA could provide a mean to implement it in the outpatient sector.

Furthermore, some interviewees identified a need for improving data linkage between hospital and outpatient sector. Storage of images in the standardised DICOM (Digital Imaging and Communications in Medicine) format and provision of patients with a CD-ROM with the images are tools currently used for data exchange. Images may be stored in a picture archiving and communication system (PACS) allowing the electronic storage, retrieval, distribution and presentation of images.

A standardised documentation of justifications for refusal of referrals was mentioned as currently under debate.

Standardisation of the MRI examination itself is difficult, as the diagnosis is a dynamic process dependent of the radiologist and the software used. A double reading – as for mammographies – could be a way to reduce variability.

Finally since 2014 there is an official catalogue for ambulatory services and concrete routine data on outpatient services will be available in 2015. Together with a standardised diagnosis documentation, this could provide the basis for future analyses and planning, including analyses of appropriateness.

... teilweise
ausbaufähig

Standardisierung von
MRI Protokollen
schwierig

Monitoring

Some of our interview partners reported internal quality control measures while one indicated that internal control is often not feasible due to a lack of resources. Internal control data are not for external use. Concerns towards external control were that clinicians would feel restricted in their clinical decision making and that quality metrics are difficult to define and would need to be adapted to local features such as case mix.

interne
Qualitätskontrolle
z. T. vorhanden,
Bedenken gegenüber
externen Kontrollen

Table 4.3-8: Interview responses: structural and organisational interventions

Role of the general practitioner
The critical use of diagnostics is a central element in the practical training of GPs.
GP would like to be the first contact point, in the position to provide directions and prevent unnecessary admissions.
There is a need for education/training on appropriate use of MRI for GPs, but they also need more competencies.
A containment of diagnostic exams requires the trustful, continuous and long-lasting relationship with the GP and his position in the system.
Communication between professionals
We check back with the referrers, if there is ambiguity.
We communicate a lot to clarify referrals, to check the indication and requested method or if the medical history is insufficient.
We communicate with the referrers in writing or per telephone if necessary. Each patient is discussed weekly. [GP] inquiry with radiologists on expected image quality.
We check referrals, but it is not really our duty.
If there is ambiguity (e.g. possible contra-indications, choice of imaging method) we clarify it with the referrers.
There is a service hotline at our institute for referrers. It is a service, not mandatory.
Standardised, digitalised information exchange
ELGA does not allow GP to make entries, here many data are lost.
Hopefully for certain areas there are data sampling standards, but the diagnosis is dependent of the radiologist and the software used. It is a dynamic process and difficult to standardise. A double reading – as for mammographies – could be a way to reduce variability.

We have electronic referrals this improves the completeness of referrals. If there is still ambiguity, we check back with the referrers. This is a standardised process.

Standardised referrals are only available in a few departments of our hospital. Insufficient justification of referrals is less a problem with external referrers. Maybe with ELGA this will be possible also in the outpatient sector.

There is no data linkage with the WGKK (health insurance) to identify repeat investigations. There are technical barriers for data exchange at the interface between outpatient sector and hospital.

The e-card would allow the identification of the patients, this is essential for data exchange and hence, the prevention of repeat investigations.

The current technology of ELGA does not allow the distribution of large imaging files.

DICOM is standardised file format, that is universally readable.

Repeat investigations are extremely rare: each patient has his images on CR-ROM, there is a dedicated department responsible for archiving them.

Referrals should be digitalised so that they can be consulted before the patient arrives.

The interpretation of the image is dependent of the radiologist, the technical quality of the device.

The MRI scan is stored in the standard DICOM format.

A standardised documentation of refusal justifications is currently a matter of debate.

Standardisation of MRI examination is difficult, there are no pre-defined windows and absolute measurements.

In previous years, there was a „black box“ of routine data on outpatient services, since 2014 there is an official catalogue and concrete routine data on outpatient services will be available 2015. Together with a standardised diagnosis documentation this could provide the basis for future analyses and planning, including analyses of appropriateness.

A standardisation of referrals would be very useful. There were plans to implement this and referrers would receive in return the image interpretation.

Monitoring

We are running an evaluation project in the acute ward, where referrals are compared with the examinations carried out. The results are for internal use only.

We have continuous quality control, but these internal controls are not standardised enough to be reported externally. External quality control is legitimate but difficult. It needs to be adjusted to the specific patient pool of each hospital.

Costs should be evaluated by department, there is a lack of awareness on costs amongst hospital personnel.

We have weekly discussion with radiologists and referrers, each case and referral is discussed, documented and quality controlled.

At our hospital, quality control is punctual due to lack of resources. There would be massive resistance from clinicians towards external quality control, as they would feel limited in their decision making.

The standardised documentation [of MRI exams] will lead to more objective data and therefore facilitate the discussion.

Regulatory and financial interventions

Capitation

**Deckelung per se
kein Instrument zur
Steuerung der
Angemessenheit**

In the outpatient clinics MRI examinations are reimbursed based on a fee-for-service model within a pre-defined limit of overall payments. It was pointed out that this limit on overall payment was not intended as a measure to specifically decrease inappropriate use. The perceptions on its impact on inappropriate use were mixed. Some stated that limited supply constitutes an incentive for referrers to reconsider the necessity of medical imaging more thoroughly. Also, longer waiting times may be a disincentive for MRI examinations in patients whose conditions would ameliorate in the meantime. Concerns were expressed with regards to acute cases: possible negative effects reported were an overload of the ambulatory departments of hospitals or the avoidance of waiting times by private payments.

**tatsächlicher Bedarf
schwer zu quantifizieren**

The quantification of the actual need is considered challenging: some interviewees stated that hospital MRI scanners are often underused. Regional variability in availability of MRI scanners does not translate in differences

in mortality. It is expected that the recently introduced standardised documentation of services provided in outpatient sector will help future planning and analyses.

Pay for performance

The current Austrian fee-for-service model does not allow to sanction either referrer or radiologists based on performance. An external quality control would therefore be entirely voluntary and is therefore unlikely to be accepted by the providers.

**pay-for-performance
derzeit keine Option**

Prior authorisation

The formal approval of imaging referrals by a representative of the health insurance was not perceived as an effective instrument to reduce inappropriate imaging. As a reason it was mentioned, that there are no guidelines with appropriateness criteria for authorisation – in fact, denials are more likely to be caused by procedural errors, than clinical necessity. It was further criticised that current processes were inadequate to take into account the specific situation of the patient.

**Chefärztliche
Bewilligung: nicht
effektiv zur Steuerung
der Angemessenheit**

One interviewee accordingly suggested the option of a mandatory second opinion from a (multidisciplinary) point-of-service as an alternative to the current prior authorisation process.

Table 4.3-9: Interview responses: regulatory and financial interventions

Capitation
Waiting times may have real disadvantages for patients.
Currently MRI usage is steered by financial restrictions [the benefit cap]. The waiting lists benefit the private sector.
The benefits cap in the outpatient sector led to reduced frequencies and longer waiting lists, which is more economically than to work in the communication with referrers and the quality of referrals: this would be an additional effort to make me earn less.
There is no increase in the expense plan for new equipment, this would not make sense because more powerful MRI scanners reduce sampling time and therefore allow to increase frequencies. For many indications scanners with lower field strengths (<1 Tesla) are as good as the higher ones, but these devices are not included in the federal equipment planning. MRI frequencies were very high until introduction of the benefits cap, which was a reaction to an austerity package not to inappropriate use. With currently available data inappropriate use cannot be analysed.
The benefits cap is co-responsible for bulging hospital costs and also poor patient care.
MRI frequencies in outpatient sector are limited by the benefit cap, but overall there is a high standard of health service.
In our hospital, the two MRI scanners are sufficient, there are no long waiting lists.
The benefits cap and the associated waiting lists leads in some cases to use of inappropriate but more accessible imaging methods (e.g. CT).
Reducing the [public] service supply will increase the private suppliers: who can afford it, will pay privately. This is against the principle of solidarity of the health system.
Waiting lists are not that bad, some cases resolve on their own, acute cases can be dealt with in acute wards. Some patients will get their exam quicker than others, depending on their health insurance.
The payment contracts with health insurers force the GP to consider the necessity of referrals.
According to unverified reports, the waiting times in the outpatient sector are regularly avoided by private payments. In the hospitals, the MRI scans are often under-utilised: there is no economic pressure, but other limitations such as availability of the personnel.
Initiatives in Germany to reduce utilisation by fixed budgets by hospital department had negative consequences for the patients, as e.g. laparoscopies were preferred over MRI due to lower costs. MRI may also help save costs, if imaging leads to avoidance of unnecessary therapies.

Quantification of need for MRI

The quantification of MRI need is a challenge. In the outpatient sector, radiologists consider themselves as service providers, in the hospitals are more critical regarding appropriate utilisation.

There is a high regional variability concerning the availability of MRIs. In Vienna there is a high availability, but long waiting times, in other regions availability is lower but this had no effect on mortality.

Many MRI scanners are located in small hospitals for formal reasons, but are underused. The overall number of devices is not representative. The patient flow needs to be improved.

A standardised documentation could provide an essential resource for future planning and analyses.

Pay for performance

An external monitoring can only be enforced within a contractual agreement. The Austrian Medical Chamber would not agree on that, not without massive concessions on another side.

A decision on the appropriateness of a procedure is not possible without knowledge of the results of clinical examination. This may even become a legal problem, if without solid evidence, a procedure is refused.

The current fee-per-service system does not allow to sanction the radiologist, nor the referrer (who has no financial interest in imaging). In a managed care model (e.g. HMO) it is possible to set financial incentives such as a fixed budget per patient and focus on quality control based on outcomes.

Pre-authorisation

The pre-authorisation was useless: referrers knew how to word their referrals to get them authorised.

The pre-authorisation interferes between patient and referrer, without knowing the patient and the situation. It is ok if referrals are refused because there is no indication, but it should not be used to limit costs.

One option could be to introduce a mandatory second opinion from a point-of-service with representatives of all fields. Precondition: available capacity and the readiness to take on the responsibility for the second opinion. Limitations: patients could be tempted to avoid centres with more rigorous control.

As pre-authorising physician it is very difficult to decide on the appropriateness of a referral, because of lack of information and the lack of guidelines.

The pre-authorisation can be easily avoided (via medical specialist or walk-in clinic).

The pre-authorisation has failed: there were also refusals for necessary exams, but the majority of referrals got authorised. There are no restrictions on private supply.

The pre-authorisation is not offensive enough. The referrers should be targeted.

95% of our referrals got authorised.

Pre-authorisation has not turned out as desired, the responsibility should be with the referrer.

The pre-authorisation was a mere formality. With the benefits cap, the institutes are under pressure to steer the referrals.

4.3.3 Summary of findings

Vielzahl an Steuerungsinstrumenten

The literature review identified a variety of instruments that were proposed to contribute to a decrease in inappropriate use of medical imaging. Additional information on some (pilot) projects (Altarum institute, PCORI) could be found per hand search.

Bildungsmaßnahmen

Educational interventions:

Training und Entscheidungshilfen

- ✿ Development and dissemination of referral guidelines, based on evidence and consensus processes
- ✿ Development of decision support tools, such as diagnostic pathways, clinical decision rules, possibly as electronic decision support tools.
- ✿ Distribution of hospital utilisation data together with imaging guidelines to raise public awareness of over-utilisation.
- ✿ Resource cards and training with simulated patients to train referrers how to address increasing patient demand.

Structural and organisational interventions:

- ❖ Revision of the professional roles: gatekeeper function of the general practitioners and expert/consultant role of radiologists
- ❖ Creation of multi-disciplinary teams to join radiologist and referring specialist expertise to coordinate medical imaging in hospitals
- ❖ Point-of-care involvement of radiologist consultation through hotlines or radiology benefits managers.
- ❖ Standardised digital referrals to ensure completeness of referral information, possibly coupled with electronic decision support.
- ❖ Quality improvement through monitoring of imaging utilisation coupled with either public reporting or with targeted educational outreach visits for referrers with outlier patterns.

strukturelle und organisatorische Interventionen

multi-disziplinäre Teams, Einbindung von RadiologInnen

standardisierte, digitalisierte Zuweisungen und Monitoring

Regulatory and financial interventions:

- ❖ Pay-for-performance models based on robust metrics and tools for performance
- ❖ Capitated payment schemes with fixed payments per patient, independent of number of procedures.
- ❖ Co-payments by patients
- ❖ Accreditation of advanced imaging providers to limit self-referral practice.
- ❖ Delisting of medical services with demonstrated low-value
- ❖ Formal approval of planned imaging procedures by the insurance company

regulatorische und finanzielle Anreize

„Pay-for-performance“-Modelle werden empfohlen

Vorab-Autorisierung

In some selective projects educational interventions, decision support tools or fixed payment schemes proved to be effective in reducing imaging over-utilisation. In general, it was mentioned, that a bundle of interventions might possibly be the most successful endeavour to change a „culture“ of inappropriate imaging.

Key findings from the interviews with our stakeholders were:

- ❖ Current workflow does not allow involvement of radiologist expertise in the decision making process
- ❖ There is a need for education and training of referrers on appropriate advanced medical imaging
- ❖ Current decision support mainly consists in the Austrian referral guidelines „Orientierungshilfe Radiologie“ and occasional exchange between radiologists and referrers.
- ❖ Patient demand is perceived as a cause for inappropriate utilisation of medical imaging.
- ❖ Standardised information exchange could contribute to improved utilisation management.
- ❖ External monitoring/pay per performance is difficult to implement in the current reimbursement model
- ❖ The current pre-authorisation system is inadequate to reduce inappropriate imaging.

wesentliche Schlussfolgerungen aus den Interviews:

Bedarf an Fortbildung, standardisiertem Informationsaustausch

Forderungen von PatientInnen relevant

derzeitige Vorab-Autorisierung unzureichend

Limitationen:	There were several limitations of our methodological approach. Due to the broad scope of our literature review with no restrictions on specific indications and interventions categories, it was not possible to conduct a systematic review and a critical appraisal of the studies identified. Most of the reported studies are observational studies. The reported effects on reduction of inappropriate imaging therefore need to be considered with caution: a causal relationship cannot necessarily be deduced. Another limitation is the restriction to studies analysing MRI: many of the interventions identified will be relevant not only to MRI but also to other advanced imaging methods.
kein systematischer Review von Interventionen	
Beschränkung auf MRT	
Überrepräsentation AllgemeinarztInnen, Fehlen anderer ZuweisenderInnen	A limitation of our stakeholder interviews was the over-representation of general practitioners as referrers. Many referrals for MRI are issued from medical specialists, <i>e.g.</i> neurologist and orthopedists. The interviews were conducted in German, as a consequence main messages of the interviews were translated by the authors in English for representation in this report. We are aware that this might have led to distortion of the initial statements.
Übersetzung der Interviews	

5 Discussion and Recommendations

The goal of the present report was to explore the need for measures to improve appropriate use of MRI in Austria. We approached this topic from several sides. In a first step, we searched for definitions to clarify the terms appropriateness/inappropriateness, over-utilisation and over-diagnosis. Second, we screened databases for recommendations against the use of MRI in specified indications and compared to the Austrian referral guideline „Orientierungshilfe Radiologie“. Third, we performed a literature review to identify which tools and strategies are used for utilisation management of MRI and their expected risks and benefits and fourth, we conducted interviews with relevant Austrian stakeholders, in which we explored their perspectives on existing and future measures to steer appropriate use of MRI in Austria.

Between 2009 and 2012 overall numbers of MRI examinations increased from 974,818 to 1,006,673, with around a fourth of the exams carried out for inpatients and the rest in an outpatient setting, either in hospital ambulatory departments or extramural outpatient imaging institutes. This makes Austria worldwide leading in the number of MRI examinations in relation to the population. The overall high numbers of imaging utilisation in Austria are indicative of potential over-utilisation, however no data on the appropriateness of MRI utilisation in Austria were available. Data detailing the MRI examinations by medical procedure (corresponding to body part) were available only for the inpatient sector. Here, major areas of MRI utilisation are MRI of head and neck and MRI of the spine, with a trend for increasing utilisation.

Our analysis yielded the following indications where recommendations against the use of MRI from appropriateness programmes and databases differed from the OGR:

Ziel des Berichts war die Identifikation von möglichen Maßnahmen, um den angemessenen Einsatz von MRT in Österreich zu steuern

zwischen 2009 und 2012 sind die MRT-Gesamtzahlen angestiegen

hohe Zahlen weisen auf einen möglicherweise übermäßigen Gebrauch hin

einige Empfehlungen weichen von Orientierungshilfe Radiologie ab

Table 5-1: Overview recommendations differing from Austrian referral guideline

Indication	Appropriateness databases	OGR
Headache in children	ACR AC: MRI head <i>with and without contrast</i> not recommended in children with chronic or recurrent primary headache, including migraine, without neurologic signs or signs of increased intracranial pressure; rated 3.	MRI is indicated as initial diagnostic method for headache in children.
Psychosis	NICE: MRI not recommended as a routine part of the initial investigations for the management of first-episode psychosis.	MRI indicated as initial diagnostic method to rule out organic reasons of psychosis.
Screening for brain metastases:		
Lung cancer	CW USA: MRI not recommended for pre-operative screening for occult brain metastases in asymptomatic patients with early lung cancer.	MRI indicated as initial diagnosis for assessing brain metastases.**
Renal cell carcinoma	ACR AC***: MRI head <i>without and with contrast</i> not recommended in post-treatment follow-up of renal cell carcinoma for asymptomatic patients; rated 1	MRI indicated as initial diagnosis for assessing brain metastases.**
Invasive bladder cancer	ACR AC***: MRI head <i>without and with contrast</i> not recommended in pre-treatment staging of invasive bladder cancer in patients with no neurologic symptoms; rated 2	MRI indicated as initial diagnosis for assessing brain metastases.**
Renal cell carcinoma	ACR AC***: MRI head <i>without and with contrast</i> not recommended in renal cell carcinoma staging for patients with no neurologic signs or other metastases; rated 1/3	MRI indicated as initial diagnosis for assessing brain metastases.**

Indication	Appropriateness databases	OGR
Uveal melanoma: Stage I or IIA/B	CAR: MRI brain not indicated for uveal melanoma staging Stage I or IIA/B. Incidence of metastases very low.	MRI indicated as initial diagnosis for assessing brain metastases.**
Uveal melanoma: Stage IIC or III	CAR: MRI brain not indicated for uveal melanoma staging Stage IIC or III with macrometastasis sentinel LN or LN dissection if no neurological symptoms.	MRI indicated as initial diagnosis for assessing brain metastases.**
Acute knee trauma	ACR AC: MRI knee <i>with and without contrast</i> not recommended for patients (excluding infants) with no symptoms; rated 1.	MRI indicated for initial diagnosis of knee trauma.
Blunt chest trauma	ACR AC: MRI chest is not indicated as follow-up in patients with normal anteroposterior chest radiograph, normal examination and normal mental status.	MRI indicated as follow-up for special issues (e.g., muscle avulsion).
Staging of bronchogenic carcinoma	ACR AC, NICE: MRI chest not indicated for staging of NSCLC. ACR AC, CAR: MRI not indicated for SCLC.	MRI indicated as follow-up (following CT examination) for staging lung carcinoma in special cases.
Incidentally discovered adrenal masses	ACR AC: MRI abdomen <i>with and without contrast</i> not indicated for adrenal masses >4cm	MRI is indicated for initial characterisation of incidentally discovered adrenal masses.
Hypertension	CAR: imaging not indicated without evidence of renal disease.	MRA „method of choice“ for initial diagnosis.

** The OGR does not specify any kind of neoplasm or setting when and if imaging is justified for the search of distant metastases; it states that MRI generally is the best method to assess brain metastases.

*** According to the ACR AC, MRI is, however, the recommended imaging technique for follow-up and retreatment of brain metastases and for their evaluation, particularly in patients being considered for surgery or radiosurgery. Therefore, the ACR AC do not rate MRI as being inappropriate to assess brain metastases in general, but identifies certain circumstances where MRI of the brain is not necessary.

Rückenschmerz ist ein vieldiskutiertes Krankheitsbild

fehlende Daten machen Rückschlüsse spekulativ

die Orientierungshilfe Radiologie ist weniger detailliert als die ACR Appropriateness Criteria

die meisten Empfehlungen beziehen sich auf MRT als Erstdiagnose-Methode

Of note, we did not find any differing recommendations for MRI of the spine. Imaging of low back pain (in the first 4-6 weeks) is one of the most prominent indications in the discussion of inappropriate imaging. Since our utilisation dataset did not include any clinical information to the MRI procedures carried out, any conclusion on the appropriateness of MRI examinations in Austria is speculative. The impact of the identified discrepancies in appropriateness definitions on MRI utilisation would need to be analysed in further studies.

Especially the ACR AC provide a comparably much more detailed guidance than the OGR, allowing to differentiate situations in which MRI is appropriate based on clinical information (e.g. differentiation by type of carcinoma, size of adrenal masses, or the presence or absence of clinical symptoms) and including recommendations on the preferred imaging protocol (e.g., with or without contrast). The majority of the recommendations identified target MRI as primary diagnostic method: this indicates the importance of highly selecting the patients based on thorough clinical examination, prior to referring them to MRI. The literature review and our interviews show that determining the appropriateness of imaging is complex and requires training, expertise and experience that referring physicians or early-stage hospital clinicians (often) are lacking.

Together with a practice of defensive medicine and increasing patient demand, this might significantly contribute to overuse of diagnostic imaging, for the sake of reassurance of both patients and physicians. Our interviews showed that the OGR has achieved a high level of awareness and acceptance in Austria, while other sources on appropriateness criteria were either not known and possibly would not be accepted as a justification for denial of an imaging procedure. It would thus be advisable to take advantage of the high awareness level and standing of the OGR and to explicitly include differentiated recommendations also on indications in which MRI is not appropriate. The recommendations on the preferred imaging protocol found in ACR guidelines will generally be less useful to referring physicians and should be left to the discretion of the imaging experts.

Due to the wide range of MRI indications, rather than globally applying decision support to all imaging indications, an economic approach would be to concentrate management efforts on selected procedures based on evidence on high levels of inappropriate utilisation, high volume and high cost of procedures. It will be important to put recommendations for the use of magnetic resonance imaging in context with other imaging modalities and in context with clinical care pathways. Restrictions or „do not do“ recommendations for one imaging modality should not result in the increased use of other modalities such as computed tomography or radiography if they are less sensitive to disease and result in increased irradiation of the patients.

More detailed referral guidelines empowering the referrers to make differentiated decisions on appropriateness of imaging are one important element to increase appropriate utilisation, but the results of our literature review suggest that guidelines should be complemented by educative measures targeting referrers and patients. These measures identified are decision support tools for referrers, resource cards and training for the discussion of appropriate imaging with patients and public awareness of over-utilisation and imaging guidelines. This was well aligned with the perceptions of our interviewees who identified a need for education and training of referrers on appropriate advanced medical imaging and patient demand as a factor contributing to inappropriate utilisation of medical imaging. Current decision support for referrers in Austria mainly consists in the Austrian referral guidelines „Orientierungshilfe Radiologie“ and occasional exchange between radiologists and referrers. An active involvement of referrers in guideline development could both serve to increase awareness and acceptance of the referral guidelines.

The implementation of decision support in the clinical workflow could be complemented by structural and organisational interventions: here, a major point was the incorporation of radiologist expertise as consultants in point-of-care models or in multi-disciplinary teams in hospitals. In Austria, this would require a revision of the professional role of radiologists. Based on the responses of our interviews, current workflow does not allow a formalised involvement of radiologist expertise in the decision making process and is limited to occasional case discussions in case of unclear referrals or concerns about contra-indications. Both in our literature search and our interviews, standardised, digital referrals were considered an essential enabling factor for information exchange to assess appropriateness of imaging requests between professionals.

Quality improvement through monitoring of imaging utilisation and pay for performance models were reported in the literature as measures that could limit inappropriate imaging. From our interviews it became clear that exter-

mehrere Faktoren führen zu potenziell übermäßigem Gebrauch von MRT

die Orientierungshilfe Radiologie ist bekannt und akzeptiert

der Fokus sollte auf ausgewählten Indikationen liegen

und alle bildgebende Verfahren in einem klinischen Pfad berücksichtigen

detaillierte Guidelines und Training für Zuweisende wären sinnvolle Maßnahmen

PatientInnen und die Öffentlichkeit sollten informiert und eingebunden werden

strukturelle und organisatorische Interventionen

neue Rolle der Radiologie

standardisierte elektronische Zuweisungen

Monitoring und *pay for performance* Modelle

nal quality monitoring would be difficult to implement, as the current reimbursement system in Austria does not allow to reward or penalize radiology providers based on their performance and hence there would be no incentive for providers to allow external audit.

Ursachen aus dem US-amerikanischen Raum treffen auf Österreich nicht zu

In contrast to the US, *e.g.*, factors contributing to over-utilisation such as „little control over number of imaging devices available to a specific population of patients” and „little action (...) to control inappropriate, financially motivated self-referral practices” do not apply to MRI utilisation in the Austrian setting: the number of imaging devices is regulated within the structural plan for large medical devices („Großgeräteplan”) [52] and patients are always referred to radiologists or radiology institutes for the imaging procedures. In addition, most health insurances require the pre-authorisation of MRI procedures in the outpatient setting. No co-payments are required for imaging services by physicians contracted to health insurances.

derzeitige Form der chefärztlichen Bewilligung nicht zielführend

In its present form, however, pre-authorisation by Austrian Health insurances is widely unpopular and not considered an appropriate measure for utilisation management based on utility criteria in our interviews. Instead, a point-of-service model with a selected network of preferred providers could be envisaged.

Standardisierung und Digitalisierung der Zuweisungen

Standardisation and digitalisation of referrals is an essential enabling factor for any such exchange between professionals: information provided might be aligned with decision support systems in order to facilitate referral review and decision making. Finally, public awareness is needed to change a culture of patient demand and defensive medicine towards a conscious and emancipated use of imaging techniques for those who really need them.

Veränderung der Nutzungskultur

Recommendations

We recommend

prospektive Beobachtungsstudien zur tatsächlichen Nutzung

- ✿ to conduct prospective studies of MRI utilisation and appropriateness using pre-specified definitions of appropriateness for selected procedures and collection of the necessary clinical parameters to determine appropriateness.

Auswahl einiger *high volume* Indikationen

- ✿ to select procedures based on evidence of high regional variability in MRI utilisation and on high volume (and costs) indications for which initiation of measures to contain inappropriate use may be warranted,

Pilotprojekte zu ausgewählten Maßnahmen

- ✿ to pilot those interventions in „motivated“ hospitals and to monitor, to evaluate and to publish the results

complemented by

Adaptierung der Orientierungshilfe Radiologie

- ✿ an initiation of a consensus building process on appropriateness criteria and adaption of the „Orientierungshilfe Radiologie” for selected procedures based on areas with missing consensus between guideline and recommendations,

Entscheidungshilfe für Zuweisende und PatientInnen

- ✿ decision support for referrers and patients and
- ✿ awareness raising of overdiagnosis and overutilisation.

6 Outlook: implications for further activities

6.1 Comparative Effectiveness Research

Medical technologies are continually changing and magnetic resonance imaging (MRI) is no exception. Not only are newer MRI modalities faster and therefore possibly more efficient, but also with increasing magnet strengths (e.g. 3.0 Tesla), more sophisticated device capabilities are offered. Whether these capabilities lead not only to differences in findings on imaging or in diagnosis, but also to increased patient relevant clinical effectiveness in differences in clinical outcomes or in clinical management in specific indications (e.g. in cerebrovascular conditions such as stroke, intracerebral aneurysms, carotid or intracerebral stenosis) is an issue in comparative assessments on advanced imaging [167].

The identification of indications for which MRI is inappropriate is complex. Elshaug *et al.* state that the search for ineffective interventions parallels comparative effectiveness research (CER) – the clinical evaluation of medical interventions relative to alternative available interventions for this intervention [168]. They further state that, due to the uncertainty because of inadequate evidence of clinical benefit, CER will most likely result in the identification of „marginal medicine“, based on the categories from Hoffman and Pearson [169]. As stated earlier, the net benefit of imaging procedures is rarely substantiated by adequate evidence of comparative evidence (category 1). On the other hand the lack of precise criteria on appropriate use can lead to overuse and misuse beyond the boundaries of established net benefit (*i.e.*, indication creep) (category 2). MRI specific items of the Institute of Medicine’s list of 100 priority comparative effectiveness research topics are [170]:

- ❖ Establish a prospective registry to compare the effectiveness of treatment strategies for low back pain without neurological deficit or spinal deformity.
- ❖ Compare the effectiveness of imaging technologies in diagnosing, staging, and monitoring patients with cancer including positron emission tomography (PET), magnetic resonance imaging (MRI), and computed tomography (CT).
- ❖ Compare the effectiveness of film-screen or digital mammography alone and mammography plus magnetic resonance imaging (MRI) in community practice-based screening for breast cancer in high risk women of different ages, risk factors, and race or ethnicity.
- ❖ Compare the effectiveness of traditional risk stratification for coronary heart disease (CHD) and non-invasive imaging (using coronary artery calcium, carotid intima media thickness, and other approaches) on CHD outcomes.
- ❖ Compare the effectiveness of traditional and newer imaging modalities (e.g., routine imaging, magnetic resonance imaging [MRI], computed tomography [CT], positron emission tomography [PET]) when ordered for neurological and orthopaedic indications by primary care practitioners, emergency department physicians, and specialists.
- ❖ Compare the effectiveness of diagnostic imaging performed by non-radiologists and radiologists.

MRT entwickelt sich laufend weiter

der tatsächliche Nutzen für PatientInnen ist Gegenstand der Forschung

CER vergleicht Interventionen mit deren Alternativen

und kann dadurch *marginal medicine* identifizieren

der Nettonutzen bildgebender Verfahren ist kaum mit adäquater Evidenz belegt

das *Institute of Medicine* listet mehrere MRT-spezifische Forschungsthemen

**neue
Anwendungsbereiche
für MRT entstehen**

Besides the need for comparative effectiveness studies, new MRI applications are on the horizon: two fields of new areas of applications with the potential of expansion of indications and with increased need for critical assessment are discussed shortly.

6.2 Molecular Imaging for „Personalised“ Medicine

**Personalisierte Medizin
als Anwendungsbereich
für MRT**

***Molecular Imaging*
unter Einsatz von
Biomarkern**

„Personalised“ Medicine/PM (also named tailor-made or precision medicine) is hyped as the future of medicine by delivering „the right treatment to the right patient at the right time“ (3 Rs). The visualisation of loco-regional physiological, biological and biochemical processes – an essential part of PM – is called „Molecular Imaging/MI“: MI differs from traditional imaging in that biomarkers are used to help image particular targets or pathways. There are three main areas in which PM is expected to have a major impact on health-management: preventive medicine, personalised diagnosis and therapeutic decisions on specific alterations [171]:

**personalisierte
Prävention**

❖ Personalised disease prevention focuses on identification – in an early pre-clinical stage –subgroups of patients at risk of developing symptoms and signs of abnormal morphology.

**personalisierte
Diagnostik**

❖ Personalised diagnostics implies the identification of the specific molecular information on alterations leading to disease.

**personalisierte
Behandlung**

❖ Personalised treatment focuses on identification of patient groups likely to respond to a given treatment or at risk of side effects, on therapy monitoring and on individualised drug delivery allowing real-time modulation of treatment.

**eine Zunahme im
onkologischen Bereich
ist absehbar**

The stratification of large patient groups in smaller sub-groups by means of (validated) biomarker identified in advanced applications of MRI is the most realistic scenario. Since most „targeted therapies“ are approved in oncology, an expansion in oncologic indications can be foreseen [172].

**der tatsächliche Nutzen
für PatientInnen muss
evaluiert werden**

To conclude: HTA research attention is been given to contrast the expectations of Molecular Imaging as technique to enable PM-therapeutic approaches with the actual patient relevant clinical outcomes. The critical validation of biomarkers as guides in PM is an essential first step [173].

6.3 Screening: Overdiagnosis and Incidental Findings

Molecular Imaging makes investigations of diseases in pre-symptomatic phases possible. Such screenings (*e.g.* for dementia) in defined populations cohorts focus on finding biomarker that allow prediction and early diagnosis of diseases and eventually preventive therapies [171]. Population imaging (<http://www.populationimaging.eu/>) as a large scale research endeavour promises „to shift the focus from curative to preventive medicine“ by finding biomarkers and predicting later stages of disease. However, Molecular Imaging approaches based on single probes/biomarker may be insufficient due to the heterogeneity of *e.g.* tumours [171].

The downside of such widespread screening of healthy individuals are overdiagnosis and incidental findings.

- ❖ Overdiagnosis is defined as the diagnosis of irrelevant disease, which is so stable or indolent that it would not have become clinically relevant during the individual´s life [171].
- ❖ Advanced diagnostic technologies such as MRI find smaller abnormalities (*e.g.* in prostate, breast and other tissues), that might never need interventions. By means of advanced imaging many precancerous and slow-growing tumours or other pathologies are treated unnecessarily.
- ❖ Advanced diagnostic technologies such as MRI lead to the expansion of the definition of disease to pre-symptomatic phases without benefit. A recent evidence-synthesis for the German Igel_Monitor on MRI for early detection of Alzheimer-dementia [174] revealed that there is no evidence on a benefit for the individual due to the lack of prognostic certainty and the lack of a treatment to prevent or delay the disease.
- ❖ Advanced diagnostic technologies lead to incidental findings nobody was searching for and nobody knows how to deal with: a recent Scottish study [175] of MRI of the skull in 700 symptom-free 70+ year old people revealed pathological findings for some kind of brain abnormality in 32%, while the prevalence in symptom-free individuals is „only“ 3%. In many of the found abnormalities the risks for death is untreated lower than with invasive treatments.

To conclude: International research attention is been given increasingly to identify fields of medical interventions where „less might be more“. Screening and early detection of diseases without proof of benefits for the individuals is one field identified.

Molecular Imaging
erlaubt die
Untersuchung von
Krankheiten in der
prä-symptomatischen
Phase

**umfassendes Screening
kann zu Überdiagnostik
und zu Zufallsbefunden
führen**

**unnötige Behandlungen
können die Folge sein**

**Ausweitung von
Krankheitsdefinitionen**

**kein Nutzen für
PatientInnen**

**erhöhte Anzahl an
Zufallsbefunden**

**der Nutzen von
Screening und
Früherkennung muss
weiter erforscht werden**

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8 Annexes

Table 8-1: Search strategies

Cochrane database	
	23.06.14
	133 Hits
ID	Search
#1	MeSH descriptor: [Diagnostic Imaging] explode all trees and with qualifier(s): [Utilization – UT]
#2	MeSH descriptor: [Magnetic Resonance Imaging] explode all trees and with qualifier(s): [Utilization – UT]
#3	(MRI* or imaging or MRT* or magnetic resonance tomograph*) near (utili*ation* or application or use*):ti,ab,kw (Word variations have been searched)
#4	#1 or #2 or #3
#5	overuse* (Word variations have been searched)
#6	MeSH descriptor: [Unnecessary Procedures] explode all trees
#7	overutili*ation* (Word variations have been searched)
#8	overdiagnos* (Word variations have been searched)
#9	appropriate use*:ti,ab,kw (Word variations have been searched)
#10	appropriateness* (Word variations have been searched)
#11	inappropriate use*:ti,ab,kw (Word variations have been searched)
#12	unnecessary near (use* or procedure* or technique* or program*) (Word variations have been searched)
#13	inappropriateness* (Word variations have been searched)
#14	MeSH descriptor: [Patient Care Management] explode all trees and with qualifier(s): [Utilization – UT]
#15	utili*ation management:ti,ab,kw (Word variations have been searched)
#16	appropriateness criteri*:ti,ab,kw (Word variations have been searched)
#17	Decision support:ti,ab,kw (Word variations have been searched)
#18	MeSH descriptor: [Guideline Adherence] explode all trees
#19	#5 or #6 or #7 or #8 or #9 or #10 or #11 or #12 or #13 or #14 or #15 or #16 or #17 or #18
#20	#4 and #19

CRD Database	
	26.06.2014
	90 Hits
1	MeSH DESCRIPTOR Magnetic Resonance Imaging
2	MeSH DESCRIPTOR Diagnostic Imaging
3	(MRI*)
4	(MRT*)
5	(imaging):TI
6	(magnetic resonance):TI
7	#1 OR #2 OR #3 OR #4 OR #5 OR #6
8	(overuse*)
9	MeSH DESCRIPTOR Unnecessary Procedures EXPLODE ALL TREES
10	(overutili*ation*)
11	(overdiagnos*)
12	(appropriate use*)

13	(appropriateness*)
14	(inappropriate use*)
15	(unnecessary NEAR (use* OR procedure* OR technique* OR program*))
16	(inappropriateness*)
17	(utili*ation management)
18	(appropriateness criteri*)
19	(decision support)
20	MeSH DESCRIPTOR Guideline Adherence EXPLODE ALL TREES
21	(utili*ation*):TI
22	#8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15 OR #16 OR #17 OR #18 OR #19 OR #20 OR #21
23	#7 AND #22

Embase
19.06.2014
483 Hits
#27. overuse* OR 'unnecessary procedure'/mj OR overutili?ation* OR 'appropriate use' OR overdiagnos* OR 'program appropriateness'/mj OR appropriateness* OR 'inappropriate use' OR unnecessary NEAR/1 (use* OR procedure* OR technique*) OR inappropriateness* OR 'utilization management' OR 'utilisation management' OR 'appropriate use' NEAR/1 criteri* OR 'appropriateness criteria' OR 'appropriate use criteria' OR 'decision support' OR 'guideline adherence' AND ('diagnostic imaging'/mj OR (imaging OR mrt* OR mri* OR 'magnetic resonance tomography') NEAR/1 (utili?ation* OR application* OR use*))
#26. 'diagnostic imaging'/mj OR (imaging OR mrt* OR mri* OR 'magnetic resonance tomography') NEAR/1 (utili?ation* OR application* OR use*)
#25. (imaging OR mrt* OR mri* OR 'magnetic resonance tomography') NEAR/1 (utili?ation* OR application* OR use*)
#24. 'diagnostic imaging'/mj
#22. overuse* OR 'unnecessary procedure'/mj OR overutili?ation* OR 'appropriate use' OR overdiagnos* OR 'program appropriateness'/mj OR appropriateness* OR 'inappropriate use' OR unnecessary NEAR/1 (use* OR procedure* OR technique*) OR inappropriateness* OR 'utilization management' OR 'utilisation management' OR 'appropriate use' NEAR/1 criteri* OR 'appropriateness criteria' OR 'appropriate use criteria' OR 'decision support' OR 'guideline adherence'
#21. 'guideline adherence'
#20. 'decision support'
#19. 'appropriate use criteria'
#18. 'appropriateness criteria'
#17. 'appropriate use' NEAR/1 criteri*
#16. 'utilisation management'
#15. 'utilization management'

#14. inappropriateness*
#13. unnecessary NEAR/1 (use* OR procedure* OR technique*)
#12. 'inappropriate use'
#11. appropriateness*
#10. 'program appropriateness'/mj
#9. overdiagnos*
#8. 'appropriate use'
#7. overutilization*
#6. 'unnecessary procedure'/mj
#5. overuse*

Ovid Medline
23.06.2014
598 Hits
1 *Magnetic Resonance Imaging/ut [Utilization]
2 *Diagnostic Imaging/ut [Utilization]
3 ((MRI* or imaging or MRT* or magnetic resonance tomograph*) adj3 (utili#ation* or application or use*)).mp.
4 1 or 2 or 3
5 overuse*.mp.
6 *Unnecessary Procedures/
7 overutili#ation*.mp.
8 overdiagnos*.mp.
9 appropriate use*.mp.
10 appropriateness*.mp.
11 inappropriate use*.mp.
12 (unnecessary adj (use* or procedure* or technique*)).mp.
13 inappropriateness*.mp.
14 exp Patient Care Management/ut [Utilization]
15 Utili#ation management.mp.
16 (appropriate use* adj criteri*).mp.
17 appropriateness criteri*.mp.
18 Decision support.mp.
19 *Guideline Adherence/
20 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19
21 4 and 20
22 remove duplicates from 21

Table 8-2: Recommendations against the use of MRI – Brain/Cranium

Indication	MEL code	Recommendation/Programme	Orientation Guide Radiology ¹
Initial diagnosis/primary investigation			
Acute concussion, unless progressive neurological symptoms, focal neurological findings or concern for a skull fracture	ZA030	CW USA: <i>Avoid ordering a brain CT or brain MRI to evaluate an acute concussion unless there are progressive neurological symptoms, focal neurological findings on exam or there is concern for a skull fracture.</i> Concussion is a clinical diagnosis. Concussion is not associated with clinically relevant abnormalities on standard neuroimaging with CT or MRI. These studies should be ordered if more severe brain injury is suspected. CT is best utilized for skull fracture and intracranial bleeding, whereas MRI may be ordered for prolonged symptoms, worsening symptoms or other suspected structural pathology.	–
Autism in adults	ZA030	NICE DB: Do not use biological tests, genetic tests or neuroimaging for diagnostic purposes routinely as part of a comprehensive assessment.	MRI indicated as initial diagnosis for developmental disorders. A.18*
Brain injury: clinically important, in patients who have sustained a head injury	ZA030	NICE DB: For safety, logistic and resource reasons, do not perform magnetic resonance imaging (MRI) scanning as the primary investigation for clinically important brain injury in patients who have sustained a head injury, although it is recognised that additional information of importance to the patient’s prognosis can sometimes be detected using MRI.	– <i>Comment: MRI may be adequate as follow-up for head injury in children.</i> M 13*
Breast cancer: local recurrence and distant metastases in asymptomatic women with Stage I Breast Cancer	ZA030	ACR AC: Stage I Breast Cancer: Initial workup and surveillance for local recurrence and distant metastases in asymptomatic women: MRI head without and with contrast to rule out metastases; rated 2 <i>Comment: Applies also for surveillance.</i>	MRI indicated as initial diagnosis for staging distant metastases and as follow-up care when US and mammography are unclear. For evaluation of distant metastases, CT/MRI/PET indicated as single examination or in combination, according to individual situation, after clearance with local tumour board L.23*, I.11*
Cerebrovascular disease	ZN270	ACR AC: Cerebrovascular disease: MRI functional (fMRI) head without contrast; rated 1	–
Cerebrovascular disease	ZA040	ACR AC: Cerebrovascular Disease: MRA head without and with contrast; Asymptomatic. Structural lesion on physical examination (cervical bruit) and/or risk factors; rated 3	–
Cerebrovascular Disease	ZA040	ACR AC: Cerebrovascular Disease: MRA neck without and with contrast for clinically suspected acute subarachnoid haemorrhage (SAH), not yet confirmed; Risk of unruptured aneurysm. Positive family history; Clinically suspected parenchymal haemorrhage (hematoma), not yet confirmed; rated 2/3	–
Dementia and movement disorders	ZN270	ACR AC: Dementia and movement disorders: MRI functional (fMRI) head without contrast; rated 2	MRI indicated as initial diagnosis for differential diagnosis. A.12*

Double Vision	ZA030	CW USA: <i>Don't routinely order imaging for all patients with double vision.</i> Many people with double vision, or diplopia, want a CT scan or MRI to see if it is caused by a brain tumour or other serious problem. Much of the time, following a comprehensive eye evaluation, neither test is necessary. The most common causes of double vision are refractive error, dry eyes, cataract and non-neurologic eye misalignment, all readily diagnosed by a complete exam. Only a minority of cases of diplopia result from problems within the brain.	–
Epilepsy: in adults with idiopathic generalized epilepsy	ZA030	CAR: Epilepsy in adults: MRI rated as specialized investigation. Imaging is not required in patients with idiopathic generalized epilepsy.	MRI indicated as initial diagnosis of epilepsy. A.16*
Eye disease: no symptoms or signs of significant disease pathology	ZA030	CW USA: <i>Don't routinely order imaging tests for patients without symptoms or signs of significant eye disease.</i> If patients do not have symptoms or signs of significant disease pathology, then clinical imaging tests are not generally needed because a comprehensive history and physical examination will usually reveal if eye disease is present or is getting worse. Examples of routine imaging include: visual-field testing; optical coherence tomography (OCT) testing; retinal imaging of patients with diabetes; and neuro imaging or fundus photography. If symptoms or signs of disease are present, then imaging tests may be needed to evaluate further and to help in treatment planning.	–
Focal neurologic deficit: unexplained acute confusion or altered level of consciousness	ZA030	ACR AC: Focal neurologic deficit: MRI head perfusion with contrast for unexplained acute confusion or altered level of consciousness; rated 3	–
Focal neurologic deficit	ZN270	ACR AC: Focal neurologic deficit: MRI functional (fMRI) head without contrast; rated 2/3	–
Headache	ZA040	ACR AC: Headache: MRA head without and with contrast for Chronic headache. No new features. Normal neurologic examination; Headache of oromaxillofacial origin; New headache. Suspected meningitis/encephalitis; New headache in pregnant woman; Positional headache; rated 2/3	MRI indicated after observation for migraine, chronic headache (tension headache). A.6*
Headache, chronic/recurrent: no focal features	ZA030	CAR: Headache chronic/recurrent: MRI indicated only in specific circumstances. In the absence of focal features imaging is not often helpful.	MRI indicated after observation in case of focal features and changes. A.6*
Headache: uncomplicated, no Red Flags	ZA030	CW CAN: <i>Don't do imaging for uncomplicated headache unless red flags are present.</i> Red flags include recent onset, rapidly increasing frequency and severity of headache; headache causing the patient to wake from sleep; associated dizziness, lack of coordination, tingling or numbness, new neurologic deficit; and new onset of a headache in a patient with a history of cancer or immunodeficiency. CW USA: <i>Don't do imaging for uncomplicated headache.</i> Imaging headache patients absent specific risk factors for structural disease is not likely to change management or improve outcome. Those patients with a significant likelihood of structural disease requiring immediate attention are detected by clinical screens that have been validated in many settings. Many studies and clinical	MRI indicated as follow-up, MRA indicated as initial diagnosis for acute, severe headache. A.5*

		practice guidelines concur. Also, incidental findings lead to additional medical procedures and expense that do not improve patient well-being.	
Headache: stable, meeting criteria for migraine	ZA030	CW USA: <i>Don't perform neuroimaging studies in patients with stable headaches that meet criteria for migraine.</i> Numerous evidence-based guidelines agree that the risk of intracranial disease is not elevated in migraine. However, not all severe headaches are migraine. To avoid missing patients with more serious headaches, a migraine diagnosis should be made after a careful clinical history and an examination that documents the absence of any neurologic findings such as papilledema. Diagnostic criteria for migraine are contained in the International Classification of Headache Disorders.	MRI indicated after observation in case of focal features and changes. A.6*
Headache: associated with cough, sexual activity or exertion	ZN260	ACR AC: Headache: MRI spine include MR myelography for headache associated with cough, sexual activity or exertion; rated 2	–
Headache in children: primary headache	ZA030	ACR AC: Headache-child: MRI head without and with contrast for primary headache (chronic or recurrent, including migraine without permanent neurologic signs or signs of increased intracranial pressure); rated 3	MRI indicated as initial diagnosis. K.10*
Headache in children: primary headache	ZA040	ACR AC: Headache child: MRA head without and with contrast for primary headache (chronic or recurrent headache including migraine without permanent neurologic signs or signs of increased intracranial pressure). If no vascular pathology is suspected based on CT or MRI; rated 1	–
Head trauma: subacute or chronic close head injury	ZN270	ACR AC: Head trauma: MRI functional (fMRI) head without contrast for subacute or chronic close head injury; rated 2	<i>Comment:</i> <i>MRI indicated for initial diagnosis of subacute, old head trauma in children.</i>
Head trauma: minor or mild acute closed head injury	ZA040	ACR AC: Head Trauma: MRA head and neck without and with contrast for minor or mild acute closed head injury (GCS ≥ 13), without risk factors or neurologic deficit; rated 3	–
Head trauma, except for special cases	ZA030	ACR AC: Head trauma: MRI with contrast except for special cases; rated 2/3 <i>Comment: CT is the most appropriate initial study for acute evaluation of the head-injured patient who may harbour lesion(s) that require immediate neurosurgical intervention.</i>	–
Head trauma: minor, unless Red Flags are present	ZA030	CW CAN: <i>Don't do imaging for minor head trauma unless red flags are present.</i> Red flags include Glasgow Coma Scale (GCS) less than 13; GCS less than 15 at 2 hours post-injury; a patient aged 65 years or older; obvious open skull fracture; suspected open or depressed skull fracture; any sign of basilar skull fracture (e.g., hemotympanum, raccoon eyes, Battle's Sign, CSF otorrhorrhea); retrograde amnesia to the event lasting 30 minutes or longer after the event; „dangerous“ mechanism (e.g., pedestrian struck by motor vehicle, occupant ejected from motor vehicle, or fall from higher than 3 feet or down more than 5 stairs); and coumadin-use or bleeding disorder.	<i>Comment:</i> <i>CT and X-ray no routine indication.</i> M.3*

Head trauma in children	ZA030	ACR AC: Head trauma-child: MRI head without and with contrast, no signs, low risk; rated 1	–
Head trauma in children	ZA030	ACR AC: Head trauma-child: MRI head with contrast for moderate – severe injury or suspected non-accidental trauma or subacute injury with neurologic signs; rated 2 <i>Comment: MRI head without contrast indicated for moderate to severe head injury or minor head trauma, suspected non-accidental trauma and sub-acute head injury.</i>	MRI indicated as follow-up for head injury. M.13*
Head trauma in children	ZA040	ACR AC: Head trauma child: MRA head without and with contrast; rated 1/2 <i>Comment: MRI and MRA head without contrast indicated for moderate to severe head injury (GCS ≤13) or minor head trauma with high-risk factors, excluding non-accidental trauma.</i>	–
Hearing loss: conductive	ZA030	ACR AC: Hearing loss/vertigo: MRI head and internal auditory canal without and with contrast for conductive hearing loss; rated 2 <i>Comment: CT of the temporal bone without contrast is the most appropriate initial imaging study in patients with conductive hearing loss.</i>	MRI indicated as follow-up. A.11*
Hearing loss and/or vertigo	ZA040	ACR AC: Hearing Loss and/or vertigo: MRA head without and with contrast; except for Persistent vertigo with or without neurological symptoms (central vertigo); rated 1	–
Intracranial disease: Colorectal cancer, distant metastases	ZA030, ZD030	NICE DB: If intracranial disease is suspected in patients with colorectal cancer, offer contrast-enhanced MRI of the brain. Do not offer imaging of the head, neck and limbs unless involvement of these sites is suspected clinically.	MRI indicated as initial diagnosis for brain metastases. L.27, A.4*
Neuroendocrine Imaging: no vascular pathology known or suspected	ZA040	ACR AC: Neuroendocrine Imaging: MRA head without and with contrast if no vascular pathology is known or suspected; rated 3	–
Psychosis, first-episode	ZN270	NICE DB: Structural neuroimaging techniques (either magnetic resonance imaging [MRI] or computed axial tomography [CT] scanning) are not recommended as a routine part of the initial investigations for the management of first-episode psychosis.	MRI indicated as initial diagnosis. A.13*
Seizures and epilepsy	ZN270	ACR AC: Seizures and epilepsy: MRI functional (fMRI) head without contrast for new-onset seizure unrelated to trauma or acute post-traumatic; rated 2/3	–
Seizures in children: simple febrile seizures and post-traumatic seizures resp. simple febrile seizures	ZA030	ACR AC: Seizures-child: MRI head without and with contrast for simple febrile seizures and post-traumatic seizures; rated 2 CW USA: Neuroimaging (CT, MRI) is not necessary in a child with simple febrile seizure. CT scanning is associated with radiation exposure that may escalate future cancer risk. MRI also is associated with risks from required sedation and high cost. The literature does not support the use of skull films in the evaluation of a child with a febrile seizure. Clinicians evaluating infants or young children after a simple febrile seizure should direct their attention toward identifying the cause of the child's fever.	–

<p>Syncope: simple, in patients with a normal neurological examination</p>	<p>ZA030</p>	<p>CAR: Febrile seizure in children: imaging not indicated. <i>Comment: Post-traumatic seizures should first be evaluated by CT. Late post-traumatic seizures may be better evaluated by MRI (ACR AC).</i></p> <p>CW CAN: – <i>Don't routinely obtain neuro-imaging studies (CT, MRI, or carotid dopplers) in the evaluation of simple syncope in patients with a normal neurological examination.</i></p> <p>Although an uncommon cause for syncope, providers must consider a neurological cause in every patient presenting with transient loss of consciousness. In the absence of signs or symptoms concerning for neurological causes of syncope (such as but not limited to focal neurological deficits), the utility of neuro-imaging studies are of limited benefit. Despite a lack of evidence for the diagnostic utility of neuroimaging in patients presenting with true syncope, providers continue to perform brain computed tomographic (CT) scans. Thus, inappropriate use of this diagnostic imaging modality carries high costs and subject patients to the risks of radiation exposure.</p> <p>CW USA: <i>In the evaluation of simple syncope and a normal neurological examination, don't obtain brain imaging studies (CT or MRI).</i> In patients with witnessed syncope but with no suggestion of seizure and no report of other neurologic symptoms or signs, the likelihood of a central nervous system (CNS) cause of the event is extremely low and patient outcomes are not improved with brain imaging studies.</p>	<p>–</p>
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<p>Syncope: simple, without other neurologic symptoms</p>	<p>ZA040</p>	<p>CW USA: – <i>Don't perform imaging of the carotid arteries for simple syncope without other neurologic symptoms.</i></p> <p>Occlusive carotid artery disease does not cause fainting but rather causes focal neurologic deficits such as unilateral weakness. Thus, carotid imaging will not identify the cause of the fainting and increases cost. Fainting is a frequent complaint, affecting 40% of people during their lifetime.</p>	<p>–</p>
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Follow-up diagnosis

<p>Brain metastases in patients symptomatic on physical examination</p>	<p>ZA030</p>	<p>ACR AC: Follow up of brain metastases: Subsequent MRI head when symptomatic on physical examination only, after treatment, for the first year; rated 3 <i>Comment: Initial MRI head ≤ 3 months is indicated.</i></p>	<p>MRI indicated as initial diagnosis. L.27*</p>
<p>Epilepsy: idiopathic generalised</p>	<p>ZA030</p>	<p>NICE DB: Neuroimaging should not be routinely requested when a diagnosis of idiopathic generalised epilepsy has been made.</p>	<p>MRI indicated as initial diagnosis. A.16*</p>
<p>Headache</p>	<p>ZA030</p>	<p>NICE DB: Do not refer people diagnosed with tension-type headache, migraine, cluster headache or medication overuse headache for neuroimaging solely for reassurance.</p>	<p>MRI indicated after observation (change of headache characteristics or focal neurologic deficit). A.6*</p>
<p>Parkinson's disease</p>	<p>ZN270</p>	<p>NICE DB: Structural magnetic resonance imaging should not be used in the differential diagnosis of Parkinson's disease.</p>	<p>MRI indicated as initial diagnosis. A.12*</p>
<p>Parkinson's disease: parkinsonian syndromes</p>	<p>ZN270</p>	<p>NICE DB: Magnetic resonance spectroscopy should not be used in the differential diagnosis of parkinsonian syndromes.</p>	<p>– <i>Comment: MRI indicated as initial diagnosis.</i> A.12*</p>

Renal cell carcinoma/Brain metastases in asymptomatic patients, after treatment	ZA030	ACR AC: Post-treatment follow-up of renal cell carcinoma: MRI head without and with contrast for asymptomatic patients; rated 1	MRI best method for diagnosis of brain metastasis. L.27* MRI indicated as initial diagnosis of renal cell carcinoma. L.15*
Staging			
Invasive bladder cancer/Brain metastases: lack of neurologic symptoms	ZA030	ACR AC: Pre-treatment staging of invasive bladder cancer: MRI head without and with contrast; rated 2	MRI best method for diagnosis of brain metastasis. L.27* MRI not indicated for diagnosis but MRI abdomen and pelvis indicated for staging of bladder cancer. L.17*
Renal cell carcinoma/Brain metastases: no neurologic symptoms or other metastases	ZA030	ACR AC: Renal cell carcinoma staging: MRI head without and with contrast for asymptomatic patients; rated 1/3	MRI best method for diagnosis of brain metastasis. L.27* MRI abdomen indicated for staging renal cell carcinoma. L.15*
Uveal melanoma/Brain metastases: Stage I or IIA/B*	ZA030	CAR: Uveal melanoma staging Stage I or IIA/B*: MRI brain not indicated. Incidence of metastasis very low.	MRI best method for diagnosis of brain metastasis. L.27*
Uveal melanoma/Brain metastases: Stage IIC or III	ZA030	CAR: Uveal melanoma staging: Stage IIC or III with macrometastasis sentinel LN or LN dissection: MRI brain not indicated if no neurological symptoms.	MRI best method for diagnosis of brain metastasis. L.27*
Screening			
Brain metastases: patients with suspected or biopsy proven Stage I NSCLC (lung cancer)	ZA030	CW USA: <i>Patients with suspected or biopsy proven Stage I NSCLC do not require brain imaging prior to definitive care in the absence of neurologic symptoms.</i> <ul style="list-style-type: none"> The incidence of occult brain metastasis in Stage I lung cancer is low (<3%) and so routine brain imaging results in increased costs, delays in therapy and rarely changes patient management. False-positive studies occur in up to 11% of patients resulting in further invasive testing or incorrect over staging, with potentially tragic effects on treatment decisions and outcomes. <p>Some clinicians perform routine screening by brain magnetic resonance imaging (MRI) or computed tomography (CT) scans to rule out occult brain metastasis in asymptomatic patients prior to surgical resection of early stage lung cancer. This practice of routine screening for occult brain metastases has not been evaluated by a randomized clinical trial and may not be cost-effective or medically necessary. Pooled data from retrospective studies that included a comprehensive clinical evaluation demonstrated that only 3% of patients who have a negative neurologic evaluation present with intracranial metastasis. One study, limited to Stage I patients, reported a prevalence of 1.3%. The joint statement of the American Thoracic Society and the European Respiratory Society did not advocate preoperative imaging of the brain in patients with NSCLC who present without neurologic symptoms, and the current National Comprehensive Cancer Network (NCCN) non-small cell lung cancer guidelines do not recommend preoperative brain imaging for asymptomatic patients with Stage IA non-small cell lung carcinoma.</p>	MRI indicated as initial diagnosis or follow-up for assessing brain metastases. L.27, L.7*

Ratings 1, 2 and 3 represent ‘usually not appropriate’; grey marking refers to overlapping recommendations

* refers to the respective chapter number in the OGR

¹ OGR usually does not specify MRI technique as contrast application, angiographic, functional or spectroscopic imaging; OGR does not specify kind of neoplasm or setting when and if imaging is justified for search of distant metastases.

Table 8-3: Recommendations against the use of MRI – Head/Neck

Indication	MEL code	Recommendation/Programme	Orientation Guide Radiology
Initial diagnosis/primary investigation			
Hoarseness, primary complaint, prior to examining the larynx	ZA030	<p>CW USA: <i>Don't obtain computed tomography (CT) or magnetic resonance imaging (MRI) in patients with a primary complaint of hoarseness prior to examining the larynx.</i></p> <p>Examination of the larynx with mirror or fiberoptic scope is the primary method for evaluating patients with hoarseness. Imaging is unnecessary in most patients and is both costly and has potential for radiation exposure. After laryngoscopy, evidence supports the use of imaging to further evaluate 1) vocal fold paralysis, or 2) a mass or lesion of the larynx.</p>	–
Rhinosinusitis: uncomplicated, acute	ZA030	<p>CW USA: <i>Don't order sinus computed tomography (CT) or indiscriminately prescribe antibiotics for uncomplicated acute rhinosinusitis.</i></p> <p>Viral infections cause the majority of acute rhinosinusitis and only 0.5 percent to 2 percent progress to bacterial infections. Most acute rhinosinusitis resolves without treatment in two weeks. Uncomplicated acute rhinosinusitis is generally diagnosed clinically and does not require a sinus CT scan or other imaging. Antibiotics are not recommended for patients with uncomplicated acute rhinosinusitis who have mild illness and assurance of follow-up. If a decision is made to treat, amoxicillin should be first-line antibiotic treatment for most acute rhinosinusitis.</p> <p><i>Don't routinely obtain radiographic imaging for patients who meet diagnostic criteria for uncomplicated acute rhinosinusitis.</i></p> <p>Imaging of the paranasal sinuses, including plain film radiography, computed tomography (CT) and magnetic resonance imaging (MRI) is unnecessary in patients who meet the clinical diagnostic criteria for uncomplicated acute rhinosinusitis. Acute rhinosinusitis is defined as up to four weeks of purulent nasal drainage (anterior, posterior or both) accompanied by nasal obstruction, facial pain-pressure-fullness or both. Imaging is costly and exposes patients to radiation. Imaging may be appropriate in patients with a complication of acute rhino-sinusitis, patients with comorbidities that predispose them to complications and patients in whom an alternative diagnosis is suspected.</p>	<p>–</p> <p><i>Comment: MRI indicated as follow-up for diseases of the paranasal sinuses (with intracranial complications and suspected malignant tumour).</i></p> <p>B.3*</p>
Sinonasal disease: acute/subacute, uncomplicated or recurrent acute or chronic rhinosinusitis	ZA030	<p>ACR AC: Sinonasal disease: MRI head and paranasal sinuses with (and without) contrast for acute or subacute uncomplicated or recurrent acute or chronic rhinosinusitis; rated 2</p> <p><i>Comment: CT of the sinuses without contrast is the imaging method of choice in patients with recurrent acute sinusitis or chronic sinusitis, or to define sinus anatomy prior to surgery.</i></p>	<p>MRI indicated as follow-up in case of affection of paranasal sinuses, intracranial complications and suspected malignant tumour.</p> <p>B.3*</p>

Sinusitis in children: uncomplicated, acute	ZA030	<p>CAR: Uncomplicated acute sinusitis in children: imaging not indicated. Mucosal thickening is frequently seen in asymptomatic children, limiting the value of imaging for ruling in/out sinusitis.</p> <p>ACR AC: Sinusitis-child: MRI paranasal sinuses without (and with) contrast; rated 1 <i>Comment: CT of the paranasal sinuses is the imaging modality of choice in patients with persistent, recurrent, or chronic sinusitis (ACR AC).</i></p>	MRI no routine indication. K.11*
Sinusitis in children, with complications	ZA030	<p>ACR AC: Sinusitis-child: MRI head without contrast for sinusitis with complications; rated 3 <i>Comment: MRI head with contrast and MRI paranasal sinuses indicated.</i></p>	MRI no routine indication. <i>Comment: MRI may be indicated for atypical course and complications.</i> K.11*

Ratings 1, 2 and 3 represent 'usually not appropriate'; grey marking refers to overlapping recommendations

* refers to the respective chapter number in the OGR

Table 8-4: Recommendations against the use of MRI – Spine/Spinal Cord

Indication	MEL code	Recommendation/Programme	Orientation Guide Radiology ¹
Initial diagnosis/primary investigation			
Low back pain: no Red Flags	ZN260	<p>ACR AC: Low back pain: MRI lumbar spine without and with contrast if no red flags; rated 2</p> <p>CW CAN: <i>Don't do imaging for lower-back pain unless red flags are present.</i> Red flags include, but are not limited to, severe or progressive neurological deficits or when serious underlying conditions such as osteomyelitis are suspected. Imaging of the lower spine before six weeks does not improve outcomes. <i>Don't do imaging for lower-back pain unless red flags are present.</i> Red flags include suspected epidural abscess or hematoma presenting with acute pain, but no neurological symptoms (urgent imaging is required); suspected cancer; suspected infection; cauda equina syndrome; severe or progressive neurologic deficit; and suspected compression fracture. In patients with suspected uncomplicated herniated disc or spinal stenosis, imaging is only indicated after at least a six-week trial of conservative management and if symptoms are severe enough that surgery is being considered.</p> <p>CW USA: <i>Don't do imaging for low back pain within the first six weeks, unless red flags are present.</i> Red flags include, but are not limited to, severe or progressive neurological deficits or when serious underlying conditions such as osteomyelitis are suspected. Imaging of the lower spine before six weeks does not improve outcomes, but does increase costs. Low back pain is the fifth most common reason for all physician visits.</p> <p>CAR: Lower back pain: MRI Indicated in special circumstances. Imaging is only indicated if there are „red flag“ indications.</p>	MRI indicated after observation. Within the first 4-6 weeks, imaging is usually not indicated. C.6*

<p>Low back pain: acute, non-specific, within first 6 weeks</p>	<p>ZN260</p>	<p>CW USA: <i>Avoid imaging studies (MRI, CT or X-rays) for acute low back pain without specific indications.</i> Imaging for low back pain in the first six weeks after pain begins should be avoided in the absence of specific clinical indications (e.g., history of cancer with potential metastases, known aortic aneurysm, progressive neurologic deficit, etc.). Most low back pain does not need imaging and doing so may reveal incidental findings that divert attention and increase the risk of having unhelpful surgery. <i>Don't recommend advanced imaging (e.g., MRI) of the spine within the first six weeks in patients with non-specific acute low back pain in the absence of red flags.</i> In the absence of red flags, advanced imaging within the first six weeks has not been found to improve outcomes, but does increase costs. Red flags include, but are not limited to: trauma history, unintentional weight loss, immunosuppression, history of cancer, intravenous drug use, steroid use, osteoporosis, age >50, focal neurologic deficit and progression of symptoms. <i>Don't obtain imaging studies in patients with non-specific low back pain.</i> In patients with back pain that cannot be attributed to a specific disease or spinal abnormality following a history and physical examination (e.g., non-specific low back pain), imaging with plain radiography, computed tomography (CT) scan, or magnetic resonance imaging (MRI) does not improve patient outcomes.</p>	<p>MRI indicated after observation. Within the first 4-6 weeks, imaging is usually not indicated. C.6*</p>
<p>Low back pain: patients over 70 years with specific symptoms</p>	<p>ZN260</p>	<p>ACR AC: Low back pain: MRI lumbar spine with contrast for patient over 70 years with specific symptoms; rated 3 <i>Comment: MRI lumbar spine without contrast indicated.</i></p>	<p>MRI indicated as initial diagnosis and after observation. C.7*</p>
<p>Low back pain: non-specific</p>	<p>ZN260</p>	<p>NICE DB: Only offer a magnetic resonance imaging (MRI) scan for non-specific low back pain within the context of a referral for an opinion on spinal fusion.</p>	<p>MRI indicated after observation. C.6*</p>
<p>Myelopathy</p>	<p>ZN260</p>	<p>ACR AC: Myelopathy: MRI spine without and with contrast if traumatic; without contrast if painful, sudden onset, stepwise or slowly, progressive, infectious or oncology patients; rated 2 <i>Comment: CT usually is the preferred first test in suspected spinal trauma.</i></p>	<p>MRI indicated as initial diagnosis in nontraumatic (C.13*) and traumatic (M.14*) situations.</p>
<p>Myelopathy</p>		<p>ACR AC: Myelopathy: MRA spine without and with contrast; traumatic, infectious disease patient, oncology patient; rated 2/3</p>	<p>–</p>
<p>Neck pain, chronic</p>	<p>ZN260</p>	<p>ACR AC: Chronic neck pain: MRI cervical spine without and with contrast as first study; rated 1</p>	<p>MRI indicated as follow-up. C.4*</p>
<p>Neck pain, chronic</p>	<p>ZN260</p>	<p>ACR AC: Chronic neck pain: MRI cervical spine with contrast except suspected infection or malignancy; rated 1</p>	<p>MRI indicated as follow-up. C.4*</p>
<p>Spine trauma, suspected</p>	<p>ZN260</p>	<p>ACR AC: Suspected acute spine trauma: MRI cervical spine without and with contrast for low-risk patients; rated 1 <i>Comment: In case of e.g. myelopathy and for the evaluation of ligamentous injury, MRI cervical spine without contrast is indicated.</i></p>	<p>MRI indicated as initial diagnosis for cervical spine trauma, indicated as follow-up for lumbar spine trauma in case of neurologic deficit. M.15/16*</p>

Spine trauma, suspected, except for children	ZN260	ACR AC: Suspected spine trauma: MRI with contrast except for children; rated 2/1	MRI indicated as initial diagnosis for cervical spine trauma, indicated as follow-up for lumbar spine trauma in case of neurologic deficit. M.15/16*
Spine trauma	ZN260	ACR AC: Suspected spine trauma: MRI (without and) with contrast for various situations; rated 1 <i>Comment: for most cases, MRI without contrast is indicated.</i>	MRI indicated as initial diagnosis for cervical spine trauma, indicated as follow-up for lumbar spine trauma in case of neurologic deficit. M.15/16*
Spine trauma, suspected	ZA040	ACR AC: Suspected Spine Trauma: MRA neck without and with contrast; except for suspected acute cervical spine trauma, Imaging indicated by clinical criteria (NEXUS or CCR), Clinical or imaging findings suggest arterial injury; rated 1	–
Follow-up diagnosis			
Spina bifida occulta	ZN260	CAR: Spina bifida occulta reported on XR, neurological findings and cutaneous stigmata of dysraphism absent in children: imaging not indicated.	MRI indicated as initial diagnosis. K.1* MRI indicated as initial diagnosis or follow-up in older children when US is fruitless. K.14*
Screening			
Spinal dysraphism, suspected in low risk infants	ZN260	CAR: Suspected spinal dysraphism, screening in low risk infants: MRI not indicated. MRI has the best diagnostic performance, but it requires sedation. It should therefore not be used as a screening modality.	MRI indicated as initial diagnosis. K.1* MRI indicated as initial diagnosis or follow-up when conspicuous/unclear US, neurologic deficit, pre-OP. K.15*

Ratings 1, 2 and 3 represent 'usually not appropriate'; grey marking refers to overlapping recommendations

* refers to the respective chapter number in the OGR

¹ OGR usually does not specify MRI technique as contrast application, angiographic, functional or spectroscopic imaging.

Table 8-5: Recommendations against the use of MRI – Musculoskeletal

Indication	MEL code	Recommendation/Programme	Orientation Guide Radiology ¹
Initial diagnosis/primary investigation			
Arm, Hand/wrist			
Elbow pain, chronic	ZD030	ACR AC: Chronic elbow pain: MRI elbow without contrast as first test; rated 1	–
Hand and wrist trauma: acute	ZD030	ACR AC: Acute hand and wrist trauma: MRI wrist without and with contrast for wrist trauma, first examination; rated 1	MRI indicated for hand/wrist trauma as follow-up. M.28/29*
Metacarpal fracture or dislocation, suspected	ZD030	ACR AC: Acute hand and wrist trauma: MRI hand without and with contrast for suspected metacarpal fracture or dislocation; rated 1	MRI indicated for hand/wrist trauma as follow-up. M.28/29*
Phalangeal fracture, suspected	ZD030	ACR AC: Acute hand and wrist trauma: MRI finger without and with contrast for suspected phalangeal fracture; rated 1	MRI indicated for hand/wrist trauma as follow-up. M.28/29*
Scaphoid fracture, suspected	ZD030	ACR AC: Acute hand and wrist trauma: MRI wrist with and without contrast for suspected acute scaphoid fracture, first examination; rated 1	MRI indicated for hand/wrist trauma as follow-up. M.28/29*
Wrist pain, chronic	ZD030	ACR AC: Chronic wrist pain, with or without prior injury: MRI wrist without and with contrast as first study; rated 1	–
Wrist pain, chronic: suspected carpal tunnel syndrome	ZD030	ACR AC: Chronic wrist pain: MRI wrist without and with contrast for suspect carpal tunnel syndrome; rated 1	–
Foot			
Ankle pain, chronic	ZE030	ACR AC: Chronic ankle pain: MRI ankle without and with contrast as best initial study; rated 1	–
Ankle trauma, acute	ZE030	ACR AC: Acute trauma to the ankle: MRI ankle (without and) with contrast; rated 1	MRI indicated as follow-up. M.32*
Foot pain, chronic	ZE030	ACR AC: Chronic foot pain: MRI foot without and with contrast as first test; rated 1	–
Foot trauma, acute	ZE030	ACR AC: Acute trauma to the foot: MRI foot without contrast as initial study, rated 1	MRI indicated as follow-up. M.32*
Hip			
Hip necrosis**	ZC030	ACR AC: Avascular necrosis of the hip: MRI hips with or without contrast as initial study; rated 1 <i>Comment: MRI hips without contrast most sensitive method for detecting AVN, but not indicated before radiographs.</i>	MRI indicated as follow-up if radiographs normal and suspected femur head necrosis. D.14*
Hip pain, acute	ZC030	ACR AC: Acute hip pain – suspected fracture: MRI pelvis and affected hip without and with contrast as first study; rated 1	–

Hip pain, chronic	ZCo30	ACR AC: Chronic hip pain: MRI hip without and with contrast as first test; rated 1	MRI indicated as follow-up if radiographs normal and suspected femur head necrosis. D.14*
Knee			
Knee pain, in children	ZEo30	ACR AC: Non-traumatic knee pain: MRI knee without and with contrast as initial examination; rated 1	– <i>Comment: MRI indicated as follow-up for all patients.</i> D.15*
Knee pain: non-traumatic	ZEo30	ACR AC: Non-traumatic knee pain: MRI knee without and with contrast as initial examination; rated 1	MRI indicated as follow-up. D.15*
Knee pain	ZEo30	CW USA: <i>Avoid ordering a knee MRI for a patient with anterior knee pain without mechanical symptoms or effusion unless the patient has not improved following completion of an appropriate functional rehabilitation program.</i> The most common cause of anterior knee pain is patellofemoral pain syndrome. Magnetic resonance imaging (MRI) is rarely helpful in managing this syndrome. Treatment should focus on a guided exercise program to correct lumbopelvic and lower limb strength and flexibility imbalances. If pain persists, if there is recurrent swelling or if mechanical symptoms such as locking and painful clicking are present, and radiographs are non-diagnostic, an MRI may be useful.	MRI indicated as follow-up for knee pain. D.15*
Knee trauma, acute	ZEo40	ACR AC: Acute Trauma to the Knee: MRA knee without and with contrast except for patients (excluding infants) with significant trauma to the knee from motor vehicle accident, suspect posterior knee dislocation. First study; rated 1	– MRI indicated as initial diagnosis. M.31*
Knee trauma, acute	ZEo30	ACR AC: Acute trauma to the knee: MRI knee without and with contrast for patients excluding infants; rated 1 <i>Comment: MRI knee without contrast indicated except for patients without symptoms.</i>	MRI indicated as initial diagnosis. M.31*
Metastatic bone disease			
Metastatic bone disease: stage 2 carcinoma of the breast with back and hip pain	ZN260	ACR AC: Metastatic bone disease: MRI hip and spine without and with contrast for stage 2 carcinoma of the breast with back and hip pain, initial presentation; rated 1	MRI indicated as follow-up for identifying skeleton metastases. L.29*
Metastatic bone disease: stage 1 breast carcinoma, hot spot/s in spine	ZN260	ACR AC: Metastatic bone disease: MRI spine with contrast for: stage 1 breast carcinoma, asymptomatic; single/three hot spot/s in spine, rated 1 <i>Comment: MRI without contrast indicated if radiographs are negative.</i>	MRI indicated as follow-up for identifying skeleton metastases. L.29*
Metastatic bone disease: stage 1 carcinoma breast	ZN660	ACR AC: Metastatic bone disease: MRI area of interest without and with contrast for stage 1 carcinoma breast, initial presentation, asymptomatic; rated 1	MRI indicated as follow-up for identifying skeleton metastases. L.29*
Metastatic bone disease in pregnant women	ZN660	ACR AC: Metastatic bone disease: MRI whole body with contrast for pregnant women; rated 1 <i>Comment: MRI without contrast indicated.</i>	–

Peripheral joints			
Inflammatory arthritis	ZN66o	CW USA: <i>Don't perform MRI of the peripheral joints to routinely monitor inflammatory arthritis.</i> Data evaluating MRI for the diagnosis and prognosis of rheumatoid arthritis are currently inadequate to justify widespread use of this technology for these purposes in clinical practice. Although bone edema assessed by MRI on a single occasion may be predictive of progression in certain RA populations, using MRI routinely is not cost-effective compared with the current standard of care, which includes clinical disease activity assessments and plain film radiography. Comment: <i>Also applies for surveillance.</i>	– MRI indicated as follow-up for unspecific joint arthropathy. D.10*
Shoulder			
Shoulder pain: acute	ZD03o	ACR AC: Acute shoulder pain: MRI shoulder without contrast, best initial study; rated 1	MRI indicated as follow-up for traumatic shoulder pain. M.27*
Soft tissue masses			
Soft tissue masses: nonspecific clinic	ZN66o	ACR AC: Soft tissue masses: MRI area of interest without and with contrast for initial examination, nonspecific clinic; rated 1 <i>Comment: Large lesions located on the abdominal or chest wall, where motion artefact can create suboptimal MR imaging, may be best evaluated with CT.</i> <i>MRI is, however, indicated for other variants of soft tissue masses.</i>	MRI indicated as initial diagnosis, follow-up and staging. D.4*
Stress fractures			
Stress fracture, prior to X-ray	ZN66o	ACR AC: Stress fracture: MRI area of interest without and with contrast as first study; rated 1	MRI indicated as follow-up. D.26*
Stress fracture	ZN66o	ACR AC: Stress fracture: MRI area of interest with contrast rated 1 except for clinical differential fracture versus metastasis in long bone. Radiographs normal, bone scan hot but nonspecific; rated 1	MRI indicated as follow-up for stress fractures. D.26*
Follow-up diagnosis			
Hand/wrist			
Distal radial fracture, suspected: acute	ZD03o	ACR AC: Acute hand and wrist trauma: MRI wrist with contrast for suspected acute distal radial fracture, radiographs normal and comminuted intra-articular distal radius fracture; rated 1 <i>Comment: MRI without contrast indicated following radiographs.</i>	MRI indicated as follow-up for hand/wrist trauma. M.28/29*
Distal radioulnar joint subluxation, suspected	ZD03o	ACR AC: Acute hand and wrist trauma: MRI wrist with contrast for suspected distal radioulnar joint subluxation; rated 1 <i>Comment: If optimum positioning of the wrist is not possible because of the injury or overlying cast, CT scanning is recommended. Repositioning the patient and scanning both wrists is more complex, time-consuming, and less comfortable with MRI compared to CT.</i>	MRI indicated for hand/wrist trauma as follow-up. M.28/29*
Hook of the hamate fracture, suspected	ZD03o	ACR AC: Acute hand and wrist trauma: MRI wrist with contrast for suspected hook of the hamate fracture, radiographs normal or equivocal; rated 1 <i>Comment: MRI without contrast indicated following radiographs.</i>	MRI indicated for hand/wrist trauma as follow-up. M.28/29*
Scaphoid fracture, suspected	ZD03o	ACR AC: Acute hand and wrist trauma: MRI wrist with contrast for suspected acute or occult scaphoid fracture, radiographs normal; rated 1 <i>Comment: MRI without contrast indicated following radiographs.</i>	MRI indicated for hand/wrist trauma as follow-up. M.28/29*

Thumb fracture or dislocation or gamekeeper injury	ZD030	ACR AC: Acute hand and wrist trauma: MRI thumb with contrast for suspected thumb fracture or dislocation or suspected gamekeeper injury; rated 1 <i>Comment: MRI without contrast indicated following radiographs.</i>	MRI indicated as follow-up for hand (ligament) injuries following hand trauma. M.29*
Wrist pain, chronic	ZD030	ACR AC: Chronic wrist pain: MRI wrist with contrast for persistent symptoms, radiographs normal/non-specific or suspected/proven Kienböck's disease or persistent pain, suspected fracture; rated 1/3 <i>Comment: Advantages of CT over MRI for the wrist include its ability to obtain high-resolution images of both wrists simultaneously, and the much shorter acquisition times for CT.</i>	–
Wrist pain, chronic	ZD030	ACR AC: Chronic wrist pain: MRI wrist without and with contrast for radiographs normal or show non-specific arthritis, exclude infection; rated 1	–
Foot			
Ankle pain, chronic	ZE030	ACR AC: Chronic ankle pain: MRI ankle with contrast as next study; rated 1, except for suspected inflammatory arthritis detected by radiographs	–
Foot pain, chronic	ZE030	ACR AC: Chronic foot pain: MRI foot for radiographs unremarkable or equivocal and clinical concern for complex regional pain syndrome type I, pain and tenderness over head of second metatarsal and clinical concern for Freiberg infraction; rated 2	–
Foot pain, chronic: various circumstances	ZE030	ACR AC: Chronic foot pain: MRI foot with contrast for painful rigid flat foot. Radiographs unremarkable or equivocal and clinical concern for tarsal coalition, Pain and tenderness over tarsus, unresponsive to conservative therapy. Radiographs showed accessory ossicle, Localized pain at the plantar aspect of the heel. Radiographs unremarkable or equivocal. Clinical concern for plantar fasciitis, Athlete with pain and tenderness overtarsal navicular. Radiographs unremarkable or equivocal. Clinical concern for stress injury or occult fracture	–
Hip			
Hip pain: chronic	ZC030	ACR AC: Chronic hip pain: MRI hip with contrast for positive radiographs and suspected infection; rated 2	–
Knee			
Imaging after total knee arthroplasty	ZE030	ACR AC: Imaging after total knee arthroplasty: MRI knee without contrast as routine follow up in asymptomatic patients or initial evaluation of suspected infection; rated 1 <i>Comment: MRI indicated following radiographs.</i>	MRI indicated as follow-up for suspected infection in patients with painful implant if radiographs negative. D.16*
Metastatic bone disease Suspected metastases, known primary tumor			
Bone metastases	ZN260	NICE DB: The routine use of spinal magnetic resonance imaging (MRI) for all men with hormone-refractory prostate cancer and known bone metastases is not recommended.	MRI indicated as follow-up for identifying skeleton metastases. L.29*
Metastatic bone disease: after radiography	ZE030	ACR AC: Metastatic bone disease: MRI femur without and with contrast for known metastatic bone disease after radiography; rated 1	MRI indicated as follow-up, unspecific radiographs. L.29*

Metastatic bone disease	ZN660	ACR AC: Metastatic bone disease: MRI area of interest without and with contrast for asymptomatic patients with prostate nodule or osteosarcoma follow up; rated 1	MRI indicated as follow-up for identifying skeleton metastases. L.29*
Metastatic bone disease	ZN660	ACR AC: Metastatic bone disease: MRI with contrast for known malignancy and pain or multiple myeloma and pain; rated 1	MRI indicated as follow-up for identifying skeleton metastases. L.29*
Metastatic spinal cord compression	ZN260	NICE DB: Metastatic spinal cord compression: In patients with a previous diagnosis of malignancy, routine imaging of the spine is not recommended if they are asymptomatic.	MRI indicated as initial diagnosis and staging of spinal cord tumours; indicated as follow-up for identifying skeleton metastases. L.2, L.29*
Musculoskeletal tumors	ZN660	ACR AC: Follow up of malignant or aggressive musculoskeletal tumours for evaluation of osseous metastatic disease from musculoskeletal primary: MRI whole body without and with contrast; rated 1 <i>Comment: MRI without contrast is indicated.</i>	MRI indicated as follow-up for identifying skeleton metastases; Indicated as initial diagnosis, control and staging of musculoskeletal tumours. L.29, L.25*
Primary bone tumours: definitely benign lesions, not osteoid osteoma	ZN660	ACR AC: Primary bone tumours: MRI area of interest with contrast for definitely benign lesions, not osteoid osteoma; <i>Comment: CT is preferred for patients with suspected osteoid osteoma or subtle cortical abnormalities, and for evaluating matrix mineralization.</i>	MRI indicated as follow-up. D.2*
Screening			
Primary bone tumours	ZN660	ACR AC: Primary bone tumours: MRI area of interest without and with contrast as screening, first study; rated 1	MRI indicated as follow-up; indicated as initial diagnosis for musculoskeletal tumours. D.2, L.25*

Ratings 1, 2 and 3 represent 'usually not appropriate'

* refers to the respective chapter number in the OGR

** Recent studies provide new insight: Mueller D, et al.: Magnetic resonance perfusion and diffusion imaging characteristics of transient bone marrow edema, avascular necrosis and subchondral insufficiency fractures of the proximal femur. *Eur J Radiol.* 2014 Oct;83(10):1862-9; Merlini L, et al.: Diffusion-weighted imaging findings in Perthes disease with dynamic gadolinium-enhanced subtracted (DGS) MR correlation: a preliminary study. *Pediatr Radiol.* 2010 Mar;40(3):318-25

¹ OGR usually does not specify MRI technique as contrast application, angiographic, functional or spectroscopic imaging; OGR does not specify kind of neoplasm or setting when and if imaging is justified for search of distant metastases.

Table 8-6: Recommendations against the use of MRI – Cardiovascular

Indication	MEL code	Recommendation/Programme	Orientation Guide Radiology
Initial diagnosis/primary investigation			
Chest pain, acute	–	ACR AC: Acute Chest Pain — Suspected Pulmonary Embolism: MRA pulmonary arteries without contrast; adults, pregnant patients; rated 3	MRI no routine indication. E.19*
Chest pain, acute	ZBo6o	ACCF AUC: Acute Chest Pain: symptomatic, High pre-test probability of CAD, ECG—ST-segment elevation and/or positive cardiac enzymes: Vasodilator Perfusion Coronary Magnetic Resonance imaging (CMR) or Dobutamine Stress Function CMR; score 1	MRI heart indicated as follow-up. E.1/2*
Chest pain	ZBo6o	ACR AC: Chest pain suggestive of acute coronary syndrome: MRI heart function and morphology without contrast; rated 3	MRI heart indicated as follow-up. E.1/2*
Chest pain, chronic	ZBo6o	ACR AC: Chronic chest pain – low to intermediate probability of coronary artery disease: MRI heart function and morphology without contrast; rated 3	MRI heart indicated as initial diagnosis of stable angina pectoris. E.3*
Chest pain, chronic	ZBo4o	ACR AC: Chronic chest pain – low to intermediate probability of coronary artery disease: MRI chest without (rated 2) and with contrast; rated 3	MRI heart indicated as initial diagnosis of stable angina pectoris. E.3*
Chest pain, chronic	–	ACR AC: Chronic Chest Pain — High Probability of Coronary Artery Disease: MRA coronary arteries without and with contrast; rated 3	–
Cold, painful leg	ZBo6o	ACR AC: Sudden onset of cold painful leg (vascular): MRI heart function and morphology without and with contrast; rated 2	MRA indicated as initial diagnosis. E.23*
Coronary artery disease	ZBo6o	ACR AC: Asymptomatic patient at risk for coronary artery disease: MRI heart function with stress without and with contrast; rated 1/2	–
Coronary artery disease	ZBo6o	ACR AC: Asymptomatic patient at risk for coronary artery disease: MRI heart function and morphology without and with contrast; rated 1/2	–
Coronary artery disease	–	ACR AC: Asymptomatic Patient at Risk for Coronary Artery Disease: MRA coronary arteries without and with contrast; rated 1-3	–
Coronary artery disease	ZBo6o	ACCF AUC: Coronary Artery disease: symptomatic, Low pre-test probability of CAD, ECG interpretable and able to exercise: Vasodilator Perfusion CMR or Dobutamine Stress Function CMR ; score 2	–
Coronary artery disease	–	ACCF AUC: Coronary Artery disease: symptomatic, intermediate pre-test probability of CAD, ECG interpretable AND able to exercise: MRA coronary arteries ; score 2 Coronary Artery disease: symptomatic, intermediate pre-test probability of CAD, ECG uninterpretable OR unable to exercise: MRA coronary arteries ; score 2	–
Coronary artery disease	–	ACCF AUC: Coronary Artery disease: symptomatic, High pre-test probability of CAD: MRA coronary arteries ; score 1	–

Coronary artery disease	-	<p>ACCF AUC: Coronary Artery disease: Post-Revascularization (PCI or CABG) – Evaluation of Chest Pain Syndrome, Evaluation of bypass grafts (score 2), History of percutaneous revascularization with stents (score 1): MRA coronary arteries</p>	-
Non-ischemic myocardial disease	ZBo40	<p>ACR AC: Non-ischemic myocardial disease with clinical manifestations: MRI chest without and with contrast; rated 1/2</p>	<p>MRI indicated as initial diagnosis for myocardial vitality. E.11*</p>
Pre-operative assessment in patients scheduled to undergo low-risk (or intermediate risk) non-cardiac surgery	ZBo60	<p>CW CAN: <i>Don't perform stress cardiac imaging or advanced non-invasive imaging as a pre-operative assessment in patients scheduled to undergo low-risk non-cardiac surgery.</i></p> <p>Non-invasive testing is not useful for patients undergoing low-risk non-cardiac surgery (e.g., cataract removal). These types of tests do not change the patient's clinical management or outcomes.</p> <p>CW USA: <i>Don't perform stress cardiac imaging or advanced non-invasive imaging as a pre-operative assessment in patients scheduled to undergo low-risk non-cardiac surgery.</i></p> <p>Non-invasive testing is not useful for patients undergoing low-risk non-cardiac surgery (e.g., cataract removal). These types of tests do not change the patient's clinical management or outcomes and will result in increased costs.</p> <p><i>Don't perform cardiac imaging as a pre-operative assessment in patients scheduled to undergo low- or intermediate-risk non-cardiac surgery.</i></p> <p>Non-invasive testing is not useful for patients undergoing low-risk non-cardiac surgery or with no cardiac symptoms or clinical risk factors undergoing intermediate-risk non-cardiac surgery. These types of testing do not change the patient's clinical management or outcomes and will result in increased costs. Therefore, it is not appropriate to perform cardiac imaging procedures for non-cardiac surgery risk assessment in patients with no cardiac symptoms, clinical risk factors or who have moderate to good functional capacity.</p> <p>ACCF AUC: Risk Assessment: Preoperative Evaluation for Non-Cardiac Surgery – Low Risk Surgery, Intermediate perioperative risk predictor: Vasodilator Perfusion CMR or Dobutamine Stress Function CMR; score 2</p>	-
Pulmonary embolism (PE), suspected	ZBo40	<p>CW USA: <i>Don't image for suspected pulmonary embolism (PE) without moderate or high pre-test probability of PE.</i></p> <p>While deep vein thrombosis (DVT) and PE are relatively common clinically, they are rare in the absence of elevated blood d-Dimer levels and certain specific risk factors. Imaging, particularly computed tomography (CT) pulmonary angiography, is a rapid, accurate and widely available test, but has limited value in patients who are very unlikely, based on serum and clinical criteria, to have significant value. Imaging is helpful to confirm or exclude PE only for such patients, not for patients with low pre-test probability of PE.</p> <p><i>Comment: MRI is only used rarely for this indication; CTA with contrast is the standard technique.</i></p>	<p>MRA no routine indication. E.19*</p>
Pulmonary hypertension	-	<p>ACR AC: Pulmonary Hypertension: MRA pulmonary arteries without contrast; rated 2 <i>Comment: MRA with contrast is indicated.</i></p>	<p>MRA indicated as initial diagnosis for hypertension. E.24*</p>

Routine evaluation: no cardiac symptoms, no high-risk markers present	ZBo6o	<p>CW CAN: <i>Don't perform stress cardiac imaging or advanced non-invasive imaging in the initial evaluation of patients without cardiac symptoms unless high-risk markers are present.</i></p> <p>Asymptomatic, low-risk patients account for up to 45 percent of unnecessary „screening“. Testing should be performed only when the following findings are present: diabetes in patients older than 40-years-old; peripheral arterial disease; or greater than 2 percent yearly risk for coronary heart disease events.</p> <p>CW USA: <i>Don't perform stress cardiac imaging or advanced non-invasive imaging in the initial evaluation of patients without cardiac symptoms unless high-risk markers are present.</i></p> <p>Asymptomatic, low-risk patients account for up to 45 percent of unnecessary „screening.“ Testing should be performed only when the following findings are present: diabetes in patients older than 40-years-old; peripheral arterial disease; or greater than 2 percent yearly risk for coronary heart disease events.</p>	–
Routine evaluation: no cardiac symptoms, no high-risk markers present	ZBo6o	<p>CW USA: <i>Don't perform stress cardiac imaging or coronary angiography in patients without cardiac symptoms unless high-risk markers are present.</i></p> <p>Asymptomatic, low-risk patients account for up to 45 percent of inappropriate stress testing. Testing should be performed only when the following findings are present: diabetes in patients older than 40 years old, peripheral arterial disease, and greater than 2 percent yearly coronary heart disease event rate.</p>	–
Stable angina: patients with chest pain of recent onset	ZBo6o	<p>NICE DB: Do not use magnetic resonance (MR) coronary angiography for diagnosing stable angina.</p>	MRI heart indicated as initial diagnosis. E.3*
Venous thromboembolism (VTE)	ZEo3o	<p>CW USA: <i>In patients with low pre-test probability of venous thromboembolism (VTE), obtain a high-sensitive D-dimer measurement as the initial diagnostic test; don't obtain imaging studies as the initial diagnostic test.</i></p> <p>In patients with low pre-test probability of VTE as defined by the Wells prediction rules, a negative high-sensitivity D-dimer measurement effectively excludes VTE and the need for further imaging studies.</p>	MRA no routine indication for pulmonary embolism. E.19*
Follow-up diagnosis			
Lower-extremity arterial bypass surgery	ZEo4o	<p>ACR AC: Follow-up of Lower-Extremity Arterial Bypass Surgery: MRA lower extremity without and with contrast for infrainguinal vein graft, Asymptomatic patient. Surveillance; rated 2</p>	–
Routine follow-up in asymptomatic patients	ZBo6o	<p>CW CAN: <i>Don't perform annual stress cardiac imaging or advanced non-invasive imaging as part of routine follow-up in asymptomatic patients.</i></p> <p>Performing stress cardiac imaging or advanced non-invasive imaging in patients without symptoms on a serial or scheduled pattern (e.g., every one to two years or at a heart procedure anniversary) rarely results in any meaningful change in patient management. This practice may, in fact, lead to unnecessary invasive procedures and excess radiation exposure without any proven impact on patients' outcomes. An exception to this rule would be for patients more than five years after a bypass operation.</p> <p>CW USA: <i>Don't perform annual stress cardiac imaging or advanced non-invasive imaging as part of routine follow-up in asymptomatic patients.</i></p> <p>Performing stress cardiac imaging or advanced non-invasive imaging in patients without symptoms on a serial or scheduled pattern (e.g., every one to two years or at a heart procedure anniversary) rarely results in any meaningful change in patient management. This practice may, in fact, lead to unnecessary invasive procedures and excess radiation exposure without any proven impact on patients' outcomes. An exception to this rule would be for patients more than five years after a bypass operation.</p>	–

Risk assessment with prior test results	ZBo6o	ACCF AUC: Risk Assessment With Prior Test Results: Normal prior stress test, High CHD risk (Framingham), Within 1 year of prior stress test: Vasodilator Perfusion CMR or Dobutamine Stress Function CMR ; score 2	–
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Ratings 1, 2 and 3 represent ‘usually not appropriate’; grey marking refers to overlapping recommendations

* refers to the respective chapter number in the OGR

Table 8-7: Recommendations against the use of MRI – Thorax

Indication	MEL code	Recommendation/Programme	Orientation Guide Radiology
Initial diagnosis/primary investigation			
Chest pain, acute	–	ACR AC: Acute non-specific chest pain- low probability of coronary artery Disease: MRA pulmonary and coronary arteries without and with contrast; rated 2/3	–
Chest pain, acute	ZBo6o	ACR AC: Acute non-specific chest pain- low probability of coronary artery disease: MRI heart function with or without stress without and with contrast; rated 3	– <i>Comment: MRI indicated as follow-up. E.1/2*</i>
Chest trauma, blunt	ZBo4o	ACR AC: First-line evaluation of blunt chest trauma; high-energy mechanism: MRI chest without (rated 1) and with (rated 2) contrast <i>Comment: CT chest with contrast, ideally performed with CTA, is indicated.</i>	MRI indicated as follow-up for chest trauma. F.2*
Pleural effusion	ZBo4o	CAR: Pleural effusion: MRI not indicated.	–
Stridor, acute	ZBo4o	CAR: Acute stridor, unstable child: imaging not indicated. Emergency airway management takes precedence over imaging.	MRI indicated as follow-up. K.28*
Thoracic Outlet Syndrome	ZBo5o	ACR AC: Imaging in the Diagnosis of Thoracic Outlet Syndrome: MRA chest without contrast; rated 2	–
Follow-up diagnosis			
Chest trauma: blunt	ZBo4o	ACR AC: Blunt chest trauma: MRI chest without (1) and with (2) contrast for patients with normal anteroposterior chest radiograph, normal examination and normal mental status, no high energy mechanism <i>Comment: Chest X-ray and CT/CTA are complementary first-line imaging modalities.</i>	MRI indicated as follow-up for chest trauma for special cases. F.2*
Dyspnoea, chronic	ZBo4o	ACR AC: Chronic dyspnoea-suspected pulmonary origin: MRI chest without and with contrast for patients of any age, non-revealing or non-diagnostic clinical, standard radiography, and laboratory studies; rated 2 <i>Comment: MRI and PET have a role in the evaluation of chest wall masses and pleural disease, but their roles in diffuse lung disease are still investigational. Investigators acknowledge the superiority of CT in diffuse lung disease.</i>	–

Pulmonary nodules	ZBo4o	ACR AC: Radiographically detected solitary pulmonary nodule: MRI chest without and with contrast for solid nodules >or = 1cm, low, moderate or high clinical suspicion for cancer; rated 2 Radiographically detected solitary pulmonary nodule: MRI chest without (rated 1) and with (rated 2) contrast for solid nodules < 1cm, low, moderate or high clinical suspicion for cancer <i>Comment: CT chest without and with contrast indicated.</i>	– Comment: <i>MRI indicated as follow-up for staging pulmonary tumours. L.7*</i>
Screening			
Pulmonary metastases	ZBo4o	ACR AC: Screening for pulmonary metastases: MRI chest without (2) and with (1) contrast for primary malignancy of bone and soft-tissue sarcoma <i>Comment: CT is indicated as initial evaluation or surveillance. Motion-related artefacts, a lower spatial resolution than CT, and an inability to detect calcification within lesions are limitations of MRI.</i>	–
Pulmonary metastases	ZBo4o	ACR AC: Screening for pulmonary metastases: MRI chest without contrast for primary malignancy of melanoma; rated 2 <i>Comment: CT chest without contrast indicated as initial evaluation or surveillance.</i>	–
Pulmonary metastases	ZBo4o	ACR AC: Screening for pulmonary metastases: MRI chest without contrast for primary malignancy of head and neck carcinoma; rated 2 <i>Comment: CT chest with contrast indicated.</i>	–
Pulmonary metastases	ZBo4o	ACR AC: Screening for pulmonary metastases: MRI chest without and with contrast for primary malignancy of testicular cancer; rated 2 <i>Comment: CT chest without contrast indicated.</i>	–
Staging			
Bronchogenic carcinoma: non-small cell and small cell lung carcinoma	ZBo4o	ACR AC: Non-invasive clinical staging of bronchogenic carcinoma: MRI chest without and with contrast for non- small cell and small cell lung carcinoma; rated 3 CAR: Staging Small Cell Lung Cancer: chest MRI not indicated <i>Comment: CT of the chest (and abdomen) with contrast is rated most appropriate for staging.</i> <i>CAR: only Small Cell lung cancer</i>	MRI indicated as follow-up procedure for staging of lung tumour in case of suspicion of infiltration of the pericardium, chest wall, central vessels spinal structures, Pancoast-Tumour. L.7*
Non-small cell lung cancer	ZBo4o	NICE DB: Magnetic resonance imaging (MRI) should not routinely be performed to assess the stage of the primary tumour (T-stage) in non-small cell Lung Cancer (NSCLC). <i>Comment: Patients with known or suspected lung cancer should be offered a contrast-enhanced chest CT scan to further the diagnosis and stage the disease.</i>	MRI indicated as follow-up for staging of lung tumour in case of suspicion of infiltration of the pericardium, chest wall, central vessels spinal structures, Pancoast-Tumour. L.7*
Lung nodules	ZBo4o	ACR AC: Metastatic bone disease: MRI chest without and with contrast for lung nodule staging; rated 1	–

Ratings 1, 2 and 3 represent 'usually not appropriate'; grey marking refers to overlapping recommendations

* refers to the respective chapter number in the OGR

Table 8-8: Recommendations against the use of MRI – Gastrointestinal tract

Indication	MEL code	Recommendation/Programme	Orientation Guide Radiology ¹
Initial diagnosis/primary investigation			
Abdominal pain, acute	ZCo30	ACR AC: Acute non-localized abdominal pain and fever or suspected abdominal abscess: MRI abdomen and pelvis with contrast in pregnant women; rated 2 <i>Comment: Because it is unclear how gadolinium-based contrast agents will affect the foetus, they should be administered only with extreme caution; only recommended during pregnancy when there are no alternatives and benefit outweighs risk. MRI without contrast is indicated.</i>	MRI indicated as follow-up for 'acute abdomen'. J.5*
Mesenteric Ischemia	ZCo40	ACR AC: Imaging of Mesenteric Ischemia: MRA abdomen without contrast for acute and chronic cases; rated 3	–
Right lower quadrant abdomen pain	ZCo30	ACR AC: Right lower quadrant abdomen pain- suspected appendicitis: MRI abdomen and pelvis with contrast in pregnant women with fever and leucocytosis; rated 2 <i>Comment: In general, CT is the most accurate imaging study for evaluating suspected appendicitis and alternative etiologies of RLQ abdominal pain.</i> <i>Comment: MRI without contrast indicated following ultrasound.</i>	MRI indicated as follow-up for appendicitis. J.2*
Right upper quadrant pain	ZCo30	ACR AC: Right upper quadrant pain: MRI abdomen with contrast in pregnant women with fever and leucocytosis; rated 3 <i>Comment: MRI without contrast indicated.</i>	MRI indicated as follow-up for 'acute abdomen'. J.5*
Follow-up diagnosis			
Lower gastrointestinal tract bleeding	ZCo30	ACR AC: Management of lower gastrointestinal tract bleeding: MRI abdomen without and with contrast; rated 1/2 for different situations	–
Small bowel obstruction, suspected	ZCo30	ACR AC: Suspected small bowel obstruction: MR enteroclysis in patients with suspected high-grade small bowel obstruction, based on clinical evaluation or initial radiography, rated 3 Suspected small bowel obstruction: MR enterography in patients with suspected high-grade small bowel obstruction, based on clinical evaluation or initial radiography, rated 3	– <i>Comment: MRI enteroclysis indicated as follow up in chronic recurring small bowel obstruction for demonstration of inflammatory changes with diffusion weighted imaging (G.10*)</i>
Screening			
Colorectal cancer	ZCo30	ACR AC: Colorectal cancer screening: MR colonography for high-risk individuals with hereditary non-polyposis colorectal cancer and/or ulcerative colitis or Crohn colitis; rated 2	–
Colorectal cancer screening after incomplete colonoscopy	ZCo30	ACR AC: Colorectal cancer screening after incomplete colonoscopy: MR colonography , rated 3 <i>Comment: CTC is the preferred test following an incomplete optical colonoscopy.</i>	–

Ratings 1, 2 and 3 represent 'usually not appropriate'

* refers to the respective chapter number in the OGR

¹ OGR usually does not specify MRI technique as contrast application, angiographic, functional or spectroscopic imaging.

Table 8-9: Recommendations against the use of MRI – Genito-urinary system

Indication	MEL code	Recommendation/Programme	Orientation Guide Radiology ¹
Initial diagnosis/primary investigation			
Adrenal mass, incidentally discovered	ZCo30	ACR AC: Incidentally discovered adrenal mass: MRI abdomen without contrast for patients with no history of malignancy, mass >4cm diameter; rated 1 <i>Comment: MRI with contrast is indicated as part of pre-operative staging.</i>	MRI indicated as initial diagnosis. H.1*
Adrenal mass, incidentally discovered	ZCo30	ACR AC: Incidentally discovered adrenal mass: MRI abdomen with contrast for patients with no history of malignancy, initial evaluation or follow-up, 1-4cm diameter; rated 2/1 <i>Comment: Also applies for follow-up. MRI without contrast is indicated.</i>	MRI indicated as initial diagnosis. H.1*
Adrenal mass, incidentally discovered	ZCo30	ACR AC: Incidentally discovered adrenal mass: MRI abdomen with contrast for patients with history of malignancy, initial evaluation, <4cm diameter; rated 1 <i>Comment: MRI without contrast indicated.</i>	MRI indicated as initial diagnosis. H.1*
Adrenal mass, incidentally discovered	ZCo30	ACR AC: Incidentally discovered adrenal mass: MRI abdomen without and with contrast for patients with history of malignancy, mass >4cm diameter; rated 1	MRI indicated as initial diagnosis. H.1*
Adnexal mass, clinically suspected	ZCo30	ACR AC: Clinically suspected adnexal mass: MRI pelvis without and with contrast for not pregnant reproductive age female with complex or solid mass detected OR postmenopausal female with simple ovarian cyst >1cm diameter; rated 3	MRI indicated as follow-up in the diagnosis of ovarian carcinoma. H.31*
Adnexal mass, clinically suspected	ZCo30	ACR AC: Clinically suspected adnexal mass: MRI pelvis without contrast for not pregnant reproductive age female with large and apparently simple cyst >5cm diameter detected; rated 3	MRI indicated as follow-up in the diagnosis of ovarian carcinoma. H.31*
Enuresis, typical	ZCo30	CAR: Typical enuresis in children: imaging not recommended. An anatomical abnormality is unlikely in the absence of unusual clinical features.	–
First trimester bleeding	ZCo30	ACR AC: First trimester bleeding: MRI pelvis without (rated 3) and with (rated 2) contrast for patients with positive pregnancy test	–
Hemospermia, transient or episodic	ZCo30	ACR AC: Hemospermia: MRI pelvis without and with contrast for men <40 years, transient or episodic hemospermia and so other symptoms; rated 3	–
Hematuria	ZCo30	ACR AC: Hematuria: MRI abdomen and pelvis without and with contrast for all patients except young females with hemorrhagic cystitis; rated 3/2	–
Hematuria in children	ZCo30	ACR AC: Hematuria-child: MRI abdomen and pelvis without and with contrast; rated 3/2 <i>Comment: To evaluate for renal calculi, CT without contrast is the most useful examination. In the setting of trauma, CT with contrast is the most useful examination, especially with macroscopic hematuria.</i>	–

Hypertension	ZCo30	CAR: Hypertension without evidence of renal disease, responsive to medication: all imaging not indicated. Imaging is not indicated if there is no evidence of renal disease.	MRA indicated as initial diagnosis for hypertension without renal disease. H.3*
Indeterminate renal mass, normal renal function	ZCo30	ACR AC: Indeterminate renal mass: MRI abdomen without contrast for patients with normal renal function; rated 3 <i>Comment: MRI with contrast indicated.</i>	MRI indicated as initial diagnosis for renal mass. L.16*
Indeterminate renal mass, renal insufficiency	ZCo30	ACR AC: Indeterminate renal mass: MRI abdomen with contrast for patients for patients with renal insufficiency; rated 3 <i>Comment: MRI without contrast indicated as clinical condition is a contraindication to intravenous contrast.</i>	MRI indicated as initial diagnosis for renal mass, as follow-up for renal insufficiency (no contrast). L.16, H.7*
Lower urinary tract infections, recurrent	ZCo30	ACR AC: Recurrent lower urinary tract infections in women: MRI pelvis without and with contrast for women with no underlying risk factors; rated 2	–
Lower urinary tract symptoms (LUTS): uncomplicated	ZCo30	NICE DB: Do not routinely offer imaging of the upper urinary tract to men with uncomplicated lower urinary tract symptoms (LUTS) at initial assessment.	–
Lower Urinary tract symptoms (LUTS)	ZCo30	CAR: Lower Urinary tract symptoms [LUTS]: MRI useful only with signs of upper tract abnormality such as azotaemia, hematuria, infection.	–
Lower urinary tract symptoms: suspicion of benign prostatic hyperplasia	ZCo30	ACR AC: Lower urinary tract symptoms- suspicion of benign prostatic hyperplasia: MRI pelvis without and with contrast; rated 2 CW USA: <i>Don't order creatinine or upper-tract imaging for patients with benign prostatic hyperplasia (BPH).</i> When an initial evaluation shows only the presence of lower urinary tract symptoms (LUTS), if the symptoms are not significantly bothersome to the patient or if the patient doesn't desire treatment, no further evaluation is recommended. Such patients are unlikely to experience significant health problems in the future due to their condition and can be seen again if necessary. [While the patient can often tell the provider if the symptoms are bothersome enough that he desires additional therapy, another possible option is to use a validated questionnaire to assess symptoms. For example, if the patient completes the International Prostate Symptom Scale (IPSS) and has a symptom score of 8 or greater, this is considered to be „clinically” bothersome.]	–
Lower urinary tract trauma, suspected	ZCo30	ACR AC: Suspected lower urinary tract trauma: MRI pelvis without and with contrast; rated 1 <i>Comment: CT of the pelvis with bladder contrast (CT cystography) is the recommended imaging study for suspected lower urinary tract injury due to a penetrating trauma of the lower abdomen or pelvis.</i>	–
Menstrual bleeding, heavy	ZCo30	NICE DB: Magnetic resonance imaging (MRI) should not be used as a first-line diagnostic tool.	–
Myometrial invasion in patients with endometrial cancer	ZCo30	ACR AC: Pre-treatment evaluation and follow up of endometrial cancer: MRI pelvis without contrast for assessing the depth of myometrial invasion; rated 3 <i>Comment: Also applies for follow-up.</i>	MRI indicated as primary investigation for local staging of endometrial cancer. L.22*

Ovarian cancer, suspected	ZCo30	NICE DB: Do not use Magnetic Resonance Imaging (MRI) routinely for assessing women with suspected ovarian cancer.	MRI indicated as initial diagnosis when US is unclear and CT not possible/contraindicated. L.20, H.31*
Pelvic floor dysfunction	ZCo30	ACR AC: Pelvic floor dysfunction: MRI pelvis endorectal coil except for clinically suspected recurrent prolapse following pelvic floor repair; rated 2	–
Pelvic pain, acute	ZCo30	ACR AC: Acute pelvic pain in the reproductive age group: MRI abdomen and pelvis with contrast for patients with gynaecological aetiology suspected, serum β -hCG positive OR non-gynaecological aetiology suspected, serum β -hCG positive; rated 1	MRI indicated as follow-up for pelvic pain with suspected endometriosis. H.28*
Prostatitis	ZCo30	CAR: Prostatitis: male chronic pelvic pain syndrome: MRI not indicated. Rarely useful in patients refractory to treatment.	–
Pyelonephritis, acute	ZCo30	ACR AC: acute pyelonephritis: MRI abdomen and pelvis without and with contrast for uncomplicated patients; rated 1	–
Renal failure: acute kidney injury	ZCo30	ACR AC: Renal failure: MRI abdomen without and with contrast for patients with acute kidney injury, unspecified; rated 2	MRI indicated as follow-up for renal failure (without contrast). H.7*
Renal failure: chronic kidney disease	ZCo30	ACR AC: Renal failure: MRI abdomen with contrast for patients with chronic kidney disease; rated 3	MRI indicated as follow-up for renal failure (without contrast). H.7*
Renal failure: acute kidney injury (AKI), unspecified	ZCo40	ACR AC: Renal Failure: MRA abdomen without and with contrast; Acute kidney injury (AKI), unspecified.	MRI indicated as follow-up for renal failure, CTA superior for kidney injury. H.7, M.26*
Reno-vascular hypertension	ZCo40	ACR AC: Reno-vascular Hypertension: MRA abdomen without and with contrast; Low index of suspicion of reno-vascular hypertension („essential“ hypertension); rated 1	MRI indicated as initial diagnosis for hypertension. E.24/H.3*
Scrotal pain, acute onset	ZCo30	ACR AC: Acute onset of scrotal pain without trauma, without antecedent mass: MRI pelvis (scrotum) without (rated 1) and with (rated 3) contrast for adults or children	–
Second and third trimester bleeding	ZCo30	ACR AC: Second and third trimester bleeding: MRI pelvis with contrast for patients with placenta previa and history of caesarean section; rated 3	–
Urinary incontinence in women	ZCo30	NICE DB: Do not use imaging (MRI , CT, X-ray) for the routine assessment of women with urinary incontinence.	MRI indicated as follow-up. H.34*
Vaginal bleeding in postmenopausal women	ZCo30	ACR AC: Abnormal vaginal bleeding: MRI pelvis without (rated 1) and with (rated 2) contrast as first study of postmenopausal bleeding or endometrium <5mm by ultrasound.	MRI indicated as follow-up for post-menopausal bleeding. H.29*
Vesicoureteric reflux (VUR) in infants and children	ZCo30	NICE DB: Routine imaging to identify vesicoureteric reflux (VUR) is not recommended for infants and children who have had a urinary tract infection (UTI), except in specific circumstances.	–

Follow-up diagnosis			
Adnexal cysts: clinically inconsequential	ZCo30	CW USA: <i>Don't recommend follow-up imaging for clinically inconsequential adnexal cysts.</i> Simple cysts and haemorrhagic cysts in women of reproductive age are almost always physiologic. Small simple cysts in postmenopausal women are common, and clinically inconsequential. Ovarian cancer, while typically cystic, does not arise from these benign-appearing cysts. After a good quality ultrasound in women of reproductive age, don't recommend follow-up for a classic corpus luteum or simple cyst <5 cm in greatest diameter. Use 1 cm as a threshold for simple cysts in postmenopausal women.	–
Pelvic floor dysfunction	ZCo30	ACR AC: Pelvic floor dysfunction: MRI pelvis dynamic with rectal contrast for clinically suspected postoperative complication following pelvic floor repair; rated 1	MRI indicated as follow-up. H.34, G.19*
Prostate cancer	ZCo30	NICE DB: Do not offer routine MRI scanning prior to salvage radiotherapy in men with prostate cancer with evidence of biochemical relapse following radical treatment.	MRI indicated as follow-up for diagnosis and initial investigation for staging prior to prostatectomy. L.18*
Urinary tract infection in children	ZCo30	NICE DB: The routine use of imaging in the localisation of a urinary tract infection (UTI) is not recommended.	MRI no routine indication. K.48*
Vaginal bleeding in premenopausal women	ZCo30	ACR AC: Abnormal vaginal bleeding: MRI pelvis without and with contrast for premenopausal vaginal bleeding, follow-up, endometrium <16mm; rated 2	–
Vaginal bleeding in premenopausal women	ZCo30	ACR AC: Abnormal vaginal bleeding: MRI pelvis without contrast for premenopausal vaginal bleeding, follow-up, endometrium >16mm; rated 3	–
Vaginal bleeding in postmenopausal women	ZCo30	ACR AC: Abnormal vaginal bleeding: MRI pelvis without contrast for postmenopausal bleeding, endometrium >5mm by ultrasound; rated 2 <i>Comment: MRI with contrast is indicated.</i>	MRI indicated as follow-up for postmenopausal bleeding. H.29*
Screening			
Prostate cancer	ZCo30	NICE DB: Magnetic resonance spectroscopy is not recommended for men with prostate cancer except in the context of a clinical trial.	–
Ovarian cancer in average and high risk women	ZCo30	ACR AC: Ovarian cancer screening: MRI pelvis without and with contrast for average and high risk women; rated 2	MRI indicated as initial diagnosis, staging and follow-up care. L.20*
Staging			
Bladder cancer, invasive	ZCo30	ACR AC: Pre-treatment staging of invasive bladder cancer: MRI abdomen without contrast; rated 3 <i>Comment: MRI with contrast is indicated. MRI pelvis without and with contrast indicated.</i>	MRI not indicated for diagnosis but indicated as follow-up for staging bladder cancer. L.17*
Prostate cancer: no radical treatment intended	ZCo30	NICE DB: Imaging is not routinely recommended for men in whom no radical treatment is intended.	–

<i>Surveillance</i>			
Bladder cancer	ZCo30	ACR AC: Post-treatment surveillance of bladder cancer: MRI abdomen and pelvis without and with contrast for patients with superficial TCC, no invasion or risk factors; rated 3	MRI not indicated for diagnosis but indicated as follow-up for staging bladder cancer. L.17*
Bladder cancer	ZCo30	ACR AC: Post-treatment surveillance of bladder cancer: MRI abdomen and pelvis without contrast for patients with superficial TCC, no invasion, with risk factors; rated 3 <i>Comment: MRI with contrast is indicated.</i>	MRI not indicated for diagnosis but indicated as follow-up for staging bladder cancer. L.17*
Gynecologic cancer	ZCo30	CW USA: <i>Avoid routine imaging for cancer surveillance in women with gynaecologic cancer, specifically ovarian, endometrial, cervical, vulvar and vaginal cancer.</i> Imaging in the absence of symptoms or rising tumour markers has shown low yield in detecting recurrence or impacting overall survival.	MRI indicated as initial diagnosis and staging ovarian cancer, staging cervical cancer and endometrial cancer. L.20, L.21, L.22*
Prostate cancer	ZCo30	CAR: Prostate cancer monitoring: MRI generally not indicated. Becoming useful in special circumstances to evaluate for intraprostatic, local and distant recurrence.	MRI indicated for follow-up and staging. L.18*

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Table 8-10: Recommendations against the use of MRI – Mamma

Indication	MEL code	Recommendation/Programme	Orientation Guide Radiology ¹
Initial diagnosis/primary investigation			
Breast micro calcifications	ZBo40	ACR AC: Breast Microcalcifications — Initial Diagnostic Workup: MRI breast without and with contrast; rated 1 Breast Microcalcifications — Initial Diagnostic Workup: Imaging localization for surgical excision breast; rated 1	–
Non-palpable mammographic findings	ZBo40	ACR AC: Non-palpable Mammographic Findings (Excluding Calcifications): MRI breast without and with contrast; rated 1	MRI indicated as follow-up and for staging after mammography. L.23/l.7, l.11*
Palpable breast masses	ZBo40	ACR AC: Palpable Breast Masses: MRI breast without (rated 1) and with contrast (rated 2)	MRI indicated as follow-up and for staging after mammography and US. l.7, l.11*
Stage I Breast Cancer in asymptomatic women	ZCo30 ZBo40	ACR AC: Stage I Breast Cancer: Initial workup and surveillance for local recurrence and distant metastases in asymptomatic women: MRI breast without contrast bilateral to rule out local recurrence; rated 1 Stage I Breast Cancer: Initial workup and surveillance for local recurrence and distant metastases in asymptomatic women: MRI abdomen without and with contrast to rule out metastases; rated 2 <i>Comment: Also applies for surveillance for local recurrence and distant metastases. With contrast: MRI breast rated 5</i>	MRI indicated for follow-up after mammography and US in women >40. l.3-5*
Follow-up diagnosis			
Biopsy-proven invasive breast cancer	ZBo40	NICE DB: The routine use of magnetic resonance imaging (MRI) of the breast is not recommended in the preoperative assessment of patients with biopsy-proven invasive breast cancer or ductal carcinoma in situ (DCIS).	MRI indicated for staging proven breast cancer after mammography, US. l.11*
Ductal carcinoma in situ	ZBo40	ACR AC: Ductal carcinoma in situ: Breast MRI prior to definitive surgery; rated 2 NICE DB: The routine use of magnetic resonance imaging (MRI) of the breast is not recommended in the preoperative assessment of patients with biopsy-proven invasive breast cancer or ductal carcinoma in situ (DCIS).	MRI indicated as follow-up for suspected Paget disease. l.7*
Screening			
Breast cancer in average-risk women	ZBo40	ACR AC: Breast cancer screening: MRI breast without and with contrast for average-risk women, breasts not dense; rated 3	MRI indicated as follow-up after unclear mammography, US. l.3-5*
Breast cancer in intermediate-risk and high-risk women	ZBo40	Breast cancer screening: MRI breast without contrast for intermediate and high risk; rated 1 <i>Comment: MRI breast with contrast indicated.</i>	MRI indicated as initial diagnosis in women with familial breast cancer history. l.2*

Surveillance			
Breast cancer	ZBo4o	NICE DB: Do not offer MRI to women: ❖ of any age at moderate risk of breast cancer ❖ of any age at high risk of breast cancer but with a 30% or lower probability of being a BRCA or TP53 carrier ❖ aged 20 to 29 years who have not had genetic testing but have a greater than 30% probability of being a BRCA carrier – aged 20 to 29 years with a known BRCA1 or BRCA2 mutation ❖ aged 50 to 69 years who have not had genetic testing but have a greater than 30% probability of being a BRCA or a TP53 carrier, unless mammography has shown a dense breast pattern ❖ aged 50 to 69 years with a known BRCA1 or BRCA2 mutation, unless mammography has shown a dense breast pattern.	MRI indicated as initial diagnosis in women with familial breast cancer history. 1.2*
Breast cancer: women aged 50 years and over	ZBo4o	NICE DB: Do not offer MRI surveillance to any women aged 50 years and over without a TP53 mutation unless mammography has shown a dense breast pattern.	MRI indicated as follow-up when mammography and US are non-conclusive. US recommended for dense breast. 1.4/5*
Early invasive breast cancer or ductal carcinoma in situ (DCIS), post-treatment	ZBo4o	NICE DB: Do not offer magnetic resonance imaging (MRI) for routine post-treatment surveillance in patients who have been treated for early invasive breast cancer or ductal carcinoma in situ (DCIS).	MRI indicated as post-treatment follow-up care after breast cancer, when recurrence is suspected. 1.12*

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