PREVENTIVE IMAGING

Preventive Imaging in the Era of Wellness Medicine

From evidence-based screening to a longitudinal phenotype of health

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Wellness is broader than prevention

Prevention opens the door; imaging can then quantify health, reveal actionable change and follow it over time.

PREVENTION

Reduce risk and detect clinically important disease before symptoms—while action can still change the trajectory.

WELLNESS

Preserve function, resilience, mobility, cognition and quality of life—not only survival.

THE ROLE FOR IMAGING

Establish a measurable baseline, identify actionable change and follow the phenotype of health.

LEVEL 1

Established preventive imaging

Defined test. Defined population. Defined action pathway.

ESTABLISHED SCREENING

Match each test to the right population

CANCER SCREENING

- Mammography · women 40/50–74
- Low-dose CT · adults 50–80 with ≥20 pack-years and current/recent smoking
- CT colonography · ages 45–75 when appropriate

RISK AND FRACTURE PREVENTION

- Coronary calcium · selected adults 40–75 at intermediate cardiovascular risk
- AAA ultrasound · one-time exam for men 65–75 who have ever smoked
- DXA · women 65 and older

Established screening changes outcomes

MORTALITY BENEFIT

- Mammography · 20–30% reduction with biennial screening; 41.7% with annual screening in the cited data
- Low-dose CT · 20% lung-cancer mortality reduction
- AAA ultrasound · 42–43% reduction in AAA-specific mortality

RISK AND DETECTION

- CT colonography · 86–100% sensitivity for polyps >10 mm
- CAC score 0 · 99% negative predictive value in the cited data
- Low bone density + treatment · 40–50% hip-fracture reduction

Evidence ranges reproduced from the source presentation.

LEVEL 1

Why established preventive programs work

DEFINED POPULATION

Eligibility is specified before the scan.

ACTIONABLE RESULT

A positive or negative result changes treatment, surveillance or intervention.

MEASURED OUTCOMES

Benefit is judged by meaningful health outcomes—not detection alone.

The discipline is the model for every newer preventive-imaging application.

Move from risk estimation to anatomy, physiology and action

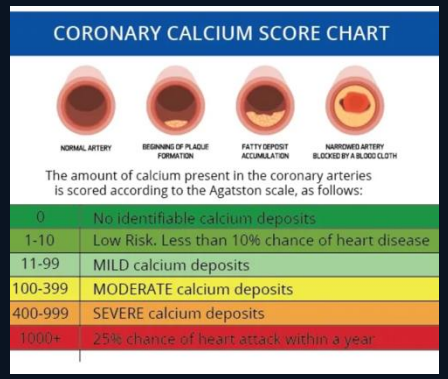
RISK FACTORS

Age · lipids · BP · diabetes · smoking

→

CAC

How much calcified plaque?



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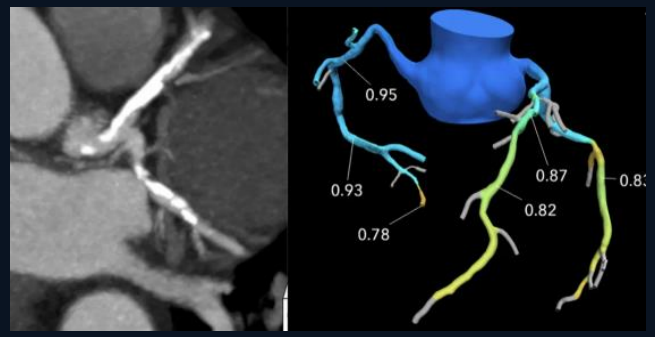
CCTA

What plaque and stenosis are present?



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FFR / FFR-CT

Is the lesion flow-limiting?

→

ACTION

Prevention · therapy · cath/PCI when indicated

CARDIAC IMAGING | JULY 24, 2019 | GREG FREIHERR

Match the test to the clinical question.

Prostate MRI supports targeted early detection

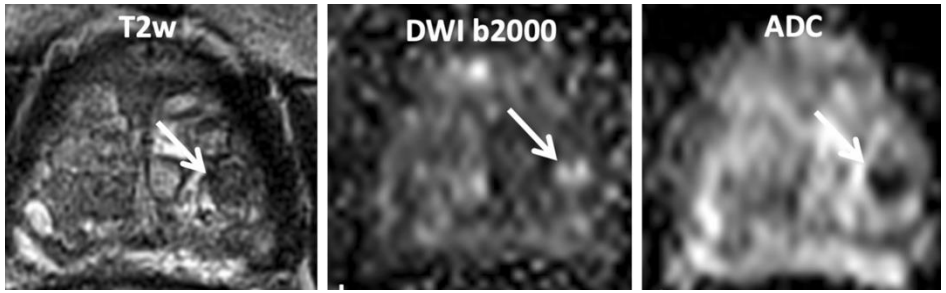
The target is clinically significant disease—not maximal lesion counting.

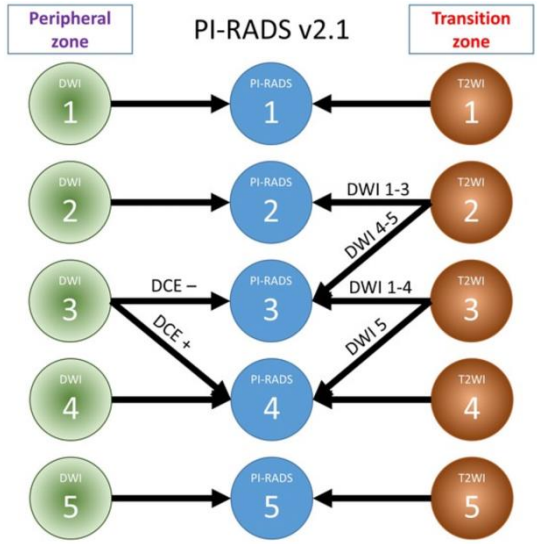
- MRI-first screening is being studied; it is not a universal population standard.

- PI-RADS standardizes suspicion and supports risk integration and biopsy targeting.

- Value rises when MRI is combined with PSA density, family history and a defined next step.

CLINICAL EXAMPLE



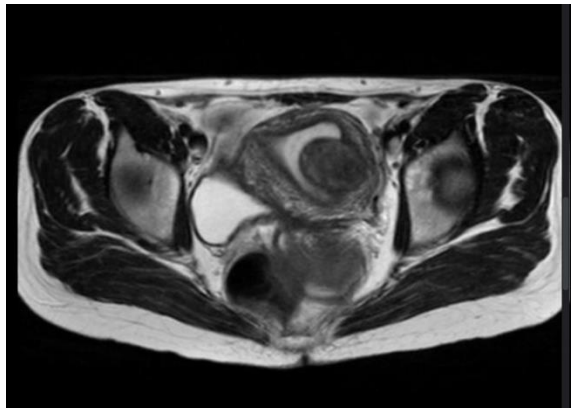


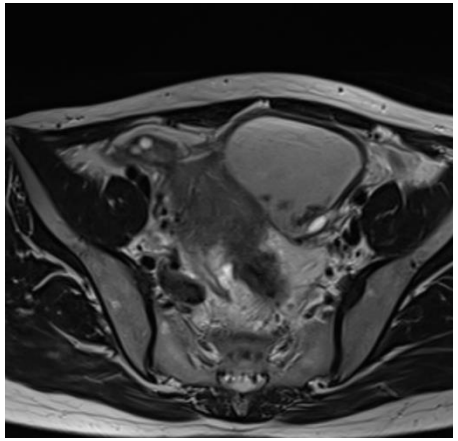
MVP MRI-vs-PSA study PMID 36351725 · STHLM3-MRI PMID 38648061 · 2026 cohort PMID 42129491

Pelvic MRI is characterization—not population screening

Average-risk ovarian screening with CA-125 and U/S has not shown a mortality benefit.

- Use MRI to characterize an indeterminate adnexal mass and stratify malignancy risk is increasing. O-RADS
- Other actionable findings include endometriosis, adenomyosis, fibroids and selected pelvic venous abnormalities.
- Separate proven screening, targeted characterization and valuable non-target detection.





O-RADS MRI Risk Stratification and Management System

O-RADS MRI Score	Risk Category	Positive Predictive Value for Malignancy*	Lexicon Description
0	Incomplete Evaluation	N/A	N/A
1	Normal Ovaries	N/A	No ovarian lesion
			Follicle defined as simple cyst ≤ 3 cm in a premenopausal woman
			Hemorrhagic cyst ≤ 3 cm in a premenopausal woman
			Corpus luteum +/- hemorrhage ≤ 3 cm in a premenopausal woman
2	Almost Certainly Benign	<0.5%^	Cyst: Unilocular- any type of fluid content • No wall enhancement • No enhancing solid tissue*
			Cyst: Unilocular – simple or endometriotic fluid content • Smooth enhancing wall • No enhancing solid tissue
			Lesion with lipid content** • No enhancing solid tissue
			Lesion with "dark T2/dark DWI" solid tissue • Homogeneously hypointense on T2 and DWI
			Dilated fallopian tube - simple fluid content • Thin, smooth wall/endosalpingeal folds with enhancement • No enhancing solid tissue
			Para-ovarian cyst – any type of fluid • Thin, smooth wall +/- enhancement • No enhancing solid tissue
3	Low Risk	~5%^	Cyst: Unilocular – proteinaceous, hemorrhagic or mucinous fluid content*** • Smooth enhancing wall • No enhancing solid tissue
			Cyst: Multilocular - Any type of fluid, no lipid content • Smooth septae and wall with enhancement • No enhancing solid tissue
			Lesion with solid tissue (excluding T2 dark/DWI dark) • Low risk time intensity curve on DCE MRI
			Dilated fallopian tube – • Non-simple fluid: Thin wall /folds • Simple fluid: Thick, smooth wall/ folds • No enhancing solid tissue
4	Intermediate Risk	~50%^	Lesion with solid tissue (excluding T2 dark/DWI dark) • Intermediate risk time intensity curve on DCE MRI • If DCE MRI is not feasible, score 4 is any lesion with solid tissue (excluding T2 dark/DWI dark) that is enhancing ≤ myometrium at 30-40s on non-DCE MRI
			Lesion with lipid content • Large volume enhancing solid tissue
5	High Risk	~80%^	Lesion with solid tissue (excluding T2 dark/DWI dark) • High risk time intensity curve on DCE MRI • If DCE MRI is not feasible, score 5 is any lesion with solid tissue (excluding T2 dark/DWI dark) that is enhancing > myometrium at 30-40s on non-DCE MRI
			Peritoneal, mesenteric or omental nodularity or irregular thickening with or without ascites

*Approximate PPV based on data from Thomassin-Naggara, et al. O-RADS MRI Score for Risk Stratification of Sonographically Indeterminate Adnexal Masses. JAMA Network Open. 2020;3(1):e1918896. Please note that the PPV provided applies to the score category overall and not to individual characteristics. Definitive PPV are not currently available for individual characteristics. The PPV values for malignancy include both borderline tumors and invasive cancers.

^ Solid tissue is defined as a lesion component that enhances and conforms to one of these morphologies: papillary projection, mural nodule, irregular septation/wall or other larger solid portions.

** Minimal enhancement of Rokitansky nodules in lesion containing lipid does not change to O-RADS MRI 4.

*** Hemorrhagic cyst ≤3cm in pre-menopausal woman is O-RADS MRI 1.

DCE = dynamic contrast enhancement with a time resolution of 15 seconds or less

DWI = diffusion weighted images

MRI = magnetic resonance imaging

Sadowski EA. Published Online: January 18, 2022
https://doi.org/10.1148/radiol.204371

From early detection to a phenotype of health

Can we in a get an objective picture of the current status of the patient’s heath?

IMAGING PHENOTYPE OF HEALTH

The measurable structural and functional characteristics captured by imaging that describe current health—not merely the presence or absence of disease.

A measurable snapshot can become a longitudinal baseline

Baseline → intervention → measurable change → clinical meaning

ROADMAP

Three levels build the imaging phenotype of health

1 · ESTABLISHED

Targeted screening with mature evidence and defined pathways.

2 · EXPANDED

Quantitative risk,
(CCTA, Prostate, pelvic MRI)

Body composition and organ-health measures—including opportunistic imaging.

3 · FRONTIER

Whole-body MRI and precision imaging: broad capability with unresolved outcome questions.

Targeted imaging becomes the method across all three levels as individual risk becomes more specific.

Imaging quantifies what the physical exam cannot

CARDIOVASCULAR

- Vascular calcification
- Carotid and aortic disease
- Selected plaque/risk markers

METABOLIC

- Visceral adiposity
- Hepatic and ectopic fat
- Sarcopenia, myosteatosis

MUSCULOSKELETAL

- Bone density
- Muscle mass / sarcopenia
- Joint and spine health

NEUROLOGICAL

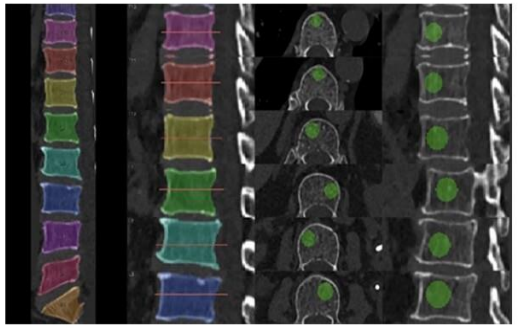
- Volume loss
- White matter lesions
- Cerebral circulation

Extract more value from scans already obtained

The future may be less about ordering more scans and more about using the information already present.

- Chest CT: coronary calcium, emphysema, vertebral attenuation, muscle and fat.
- Abdominal CT/MRI: visceral fat, liver fat, muscle mass, vascular calcification and bone density.
- AI can make extraction practical—but software, workflow, standards and reader time are not free.

DL Opportunistic CT Osteoporosis Screening and the Establishment of Normative Values



- 538,946 CT exams from 283,499 patients using different scanner models and protocols
- CNN accurately identified 3D ROI in thoracic and lumbar vertebrae to measure trabecular attenuation
- CT tube voltage had greater influence on image attenuation values than the scanner model
- Threshold of 80 HU for the L1 vertebra for diagnosing osteoporosis was identified with automated 3D ROI

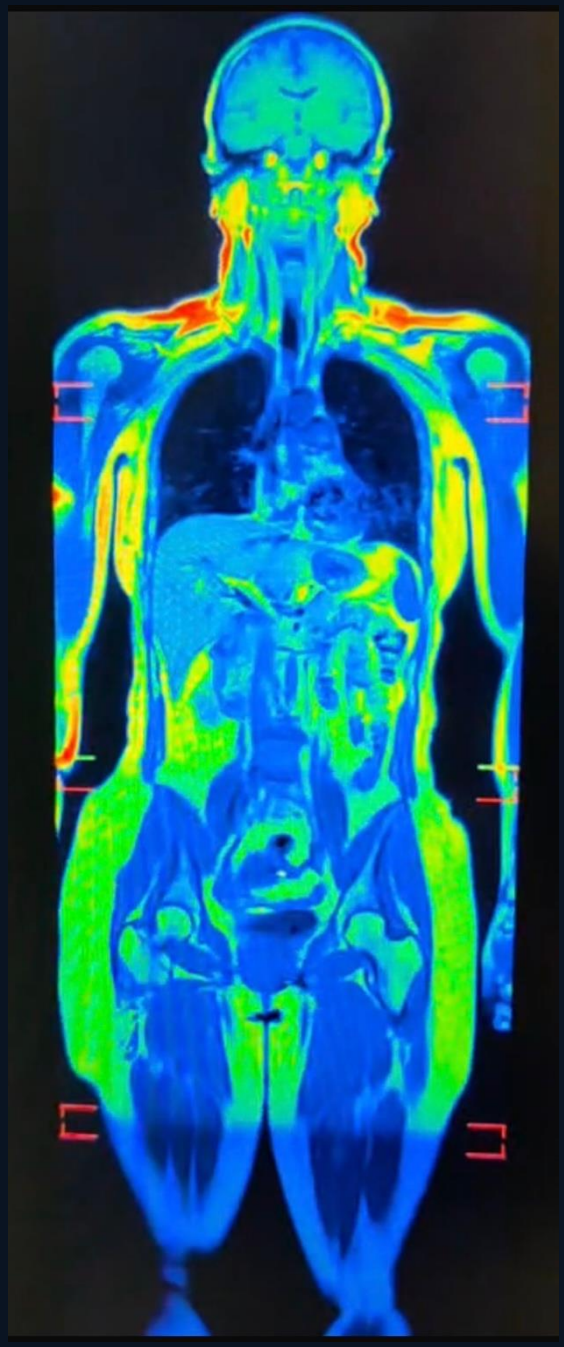
Westerhoff M et al. Published: November 11, 2025
https://doi.org/10.1148/radiol.250917
Radiology

WBMRI

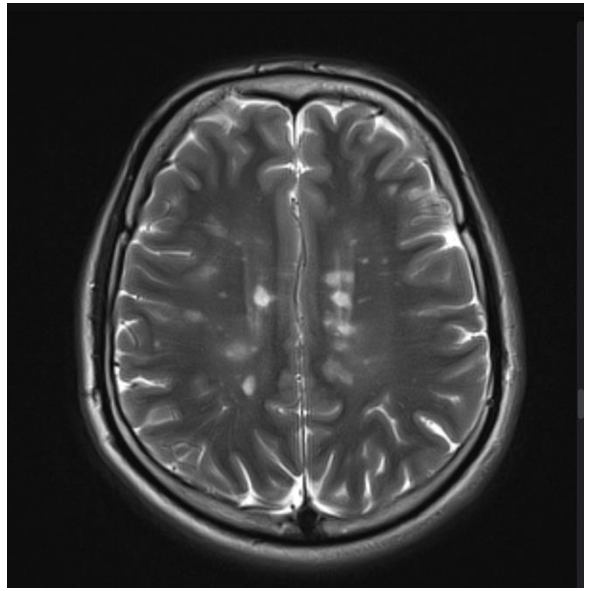
One examination can create a broad structural baseline

Broad coverage and no ionizing radiation make longitudinal assessment conceptually attractive.

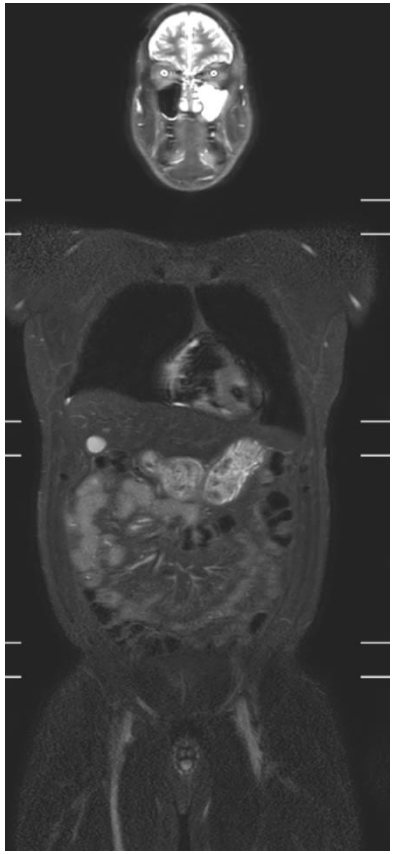
Capability is not the same as proven population benefit.

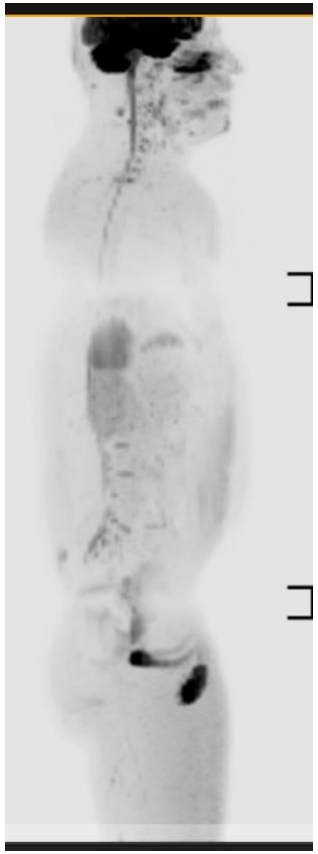


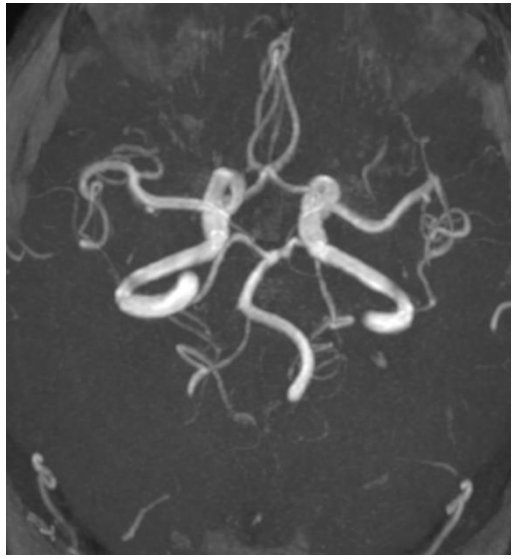
Whole-body MRI image retained from the source presentation.

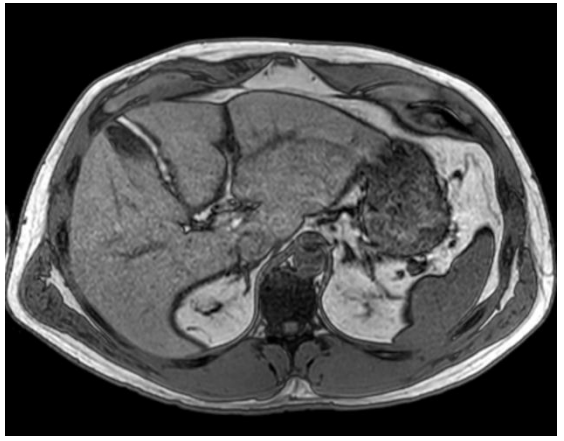


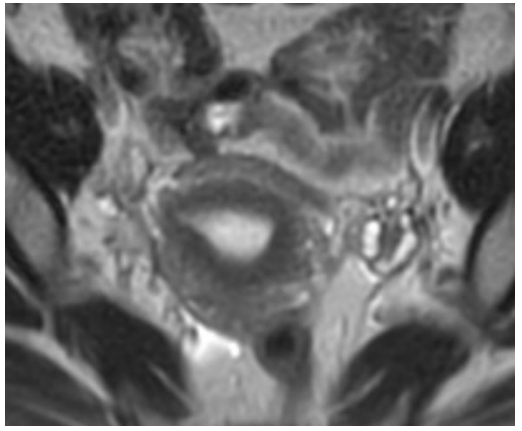
59517991 mm (5 mm)











LEVEL 3

Why whole-body MRI is attractive

BROAD COVERAGE

Multiple organs, marrow and soft tissues in one examination.

NO IONIZING RADIATION

Repeated or longitudinal assessment is conceptually attractive.

ONE ENCOUNTER

Potential to combine oncologic detection with selected structural information.

The key question is

“What can we find?”

Which findings improve an outcome when discovered in an asymptomatic person?

The balance sheet has three parts

POTENTIAL VALUE

MCD-Multicancer detection (1-2%)
Renal, lung, prostate, thyroid, urothelial**. Liver, Ovaries, brain, marrow disease. Adenopthy.
Body Composition*corelates biomarkers.
Neurovascular screening (2-3%)
MSK

UNCERTAINTY

No demonstrated mortality benefit for average-risk population screening**

Protocols and follow-up vary.

COST OF KNOWING

Incidental findings vs Accionable Finding. Repeat imaging, consultation, procedures. Anxiety and overdiagnosis.

AJR Accepted Manuscript

Whole-Body MRI in Asymptomatic Individuals: Promise and Perils—*AJR* Expert Panel Review

Giuseppe Petralia, MD, Oguz Akin, MD, Claire Brookmeyer, MD, Linda C. Chu, MD, Preethi R. Guniganti, MD, Mina S. Makary, MD, Lucy Muinov, MD, Michael H. Rosenthal, MD, PhD, Fabio Zugni, MD, Daniel J. A. Margolis, MD

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Article Section: Policy, Quality, and Practice Management

The complete title page, as provided by the authors, is available at the end of this article.

Abstract

This *AJR* Expert Panel Narrative Review examines current and emerging applications of whole-body MRI (WB-MRI) in asymptomatic individuals, addressing the examination's promise and pitfalls in context of available evidence. WB-MRI is being used in asymptomatic individuals primarily for multicancer detection, with research to date focusing on detection frequencies. Nononcologic applications include intracranial aneurysm detection, quantitative body composition analysis, and musculoskeletal assessment. Standardized acquisition and reporting frameworks and artificial intelligence workflows are being pursued to support WB-MRI implementation. WB-MRI is increasingly performed in the general population (i.e., individuals without cancer risk factors) as preventive healthcare, partly driven by a growing commercial market, despite limited evidence supporting clinical impact and lack of guidelines endorsing the practice. Moreover, WB-MRI carries potential harms from workup of indeterminate findings, overdiagnosis and overtreatment of indolent disease, and substantial direct and downstream costs. Additional ethical dilemmas relate to unregulated commercial advertising, appropriate informed consent, and psy-

ACCEPTED MANUSCRIPT

Whole-body MRI belongs inside a governed pathway

- Broad detection is different from proven population-level benefit.
- Does NOT replace established screening programs.
- Use of standardized* protocols (e.g. ONCO-RADS) and structured reporting will help data analysis.
- Predefine pathways for indeterminate findings.
- Track significant findings, recalls, additional imaging, procedures and complications.

Non-target findings can improve quality of life… Conventional Dx imaging experience

"Incidental" describes how a finding was discovered—not whether it matters.

- Pelvis: endometriosis, adenomyosis, fibroids or adnexal masses.
- Renal / Pancreas lesions.
- Spine / MSK: stenosis, osteonecrosis, occult injury, tendon or joint pathology.
- Metabolic: hepatic steatosis, visceral adiposity, low muscle mass and bone-health clues.
- Neuro: small-vessel burden, white matter lesions.

Structural baseline and selected actionable lesions.

ORIGINAL ARTICLE ■ *Leadership*

Developing Algorithm-Based Recommendations in the ACR: Defining a New Process

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Jacqueline A. Bello, MD[d], Lincoln Berland, MD[e], Jay Bronner, MD[f], My
David Kurth, MA, MPH[h], Etta Pisano, MD[i], James V. Rawson, MD[j], Da
Jeffrey Weinreb, MD[l], Hanna M. Zafar, MD, MHS[m], Pari V. Pandharipa

Abstract

We summarize a new process for developing algorithm-based recommendations for the ACR. This process
incidental findings recommendations, and other committees providing evidence-based recommendations m
the future. The prior process relied upon informal consensus and was versatile but more limited in scal
importantly, the absence of a formal, evidence-driven process prevented incidental findings and other algorit
clinical guidelines per the National Academy of Medicine's Trustworthy Guidelines criteria and limited both
In response, a committee of key stakeholders was formed with approval of the ACR to develop a new p
drawbacks, including members from the ACR's Incidental Findings and Reporting and Data Systems comm
Quality and Safety and Informatics, academic and private practice settings, as well as ACR staff. Here we p
process for algorithm-based imaging recommendations developed by this committee. This process is generaliz

Key Words: Evidence synthesis, incidental finding, process, quality, recommendations

J Am Coll Radiol 2026;23:312-317. © 2025 American College of Radiology. Published by Elsevier Inc.
those for text and data mining, AI training, and similar technologies.

Targeted MRI gains value as individual risk becomes specific

WHO?

- Family or genetic risk
- Biomarker or laboratory signal
- Prior indeterminate imaging
- Organ-specific risk
- Localized Pain Syndromes

WHAT?

- Prostate MRI
- High-risk breast MRI
- Selected brain / vascular MRI
- Pelvic MRI
- Abdominal MRI
- MSK MRI

WHY?

- Higher pre-test probability
- Focused protocol
- Clear management pathway
- Better detection/testing balance

Preventive imaging has more than one endpoint

LIVE LONGER
(NOT PROVEN)

Earlier detection may change major disease outcomes.

LIVE BETTER

Actionable findings can affect pain, fertility, function, mobility and quality of life.

KNOW YOUR BASELINE

A reproducible structural and tissue-composition baseline adds context to future change.

A preventive imaging report can become longitudinal

Not just:

“No acute abnormality.”

But:

“What does this scan say about future risk?”

Cardiovascular ·

Body Composition-Metabolic : visceral fat · liver fat · muscle mass

MSK: bone density · Degenerative

Neurocognitive/Neurovascular

Use Imaging To Monitor Treatment Response

METABOLIC

Quantify visceral and subcutaneous fat, liver fat, muscle quantity and muscle quality.

STRUCTURAL / RECOVERY

Use predefined tendon, cartilage, muscle and bone endpoints—primarily as research questions.

NEURO / OTHER

Use MRI for selection, safety and response where evidence supports it; biomarkers complement clinical outcomes.

ESTABLISHED • EMERGING • INVESTIGATIONAL

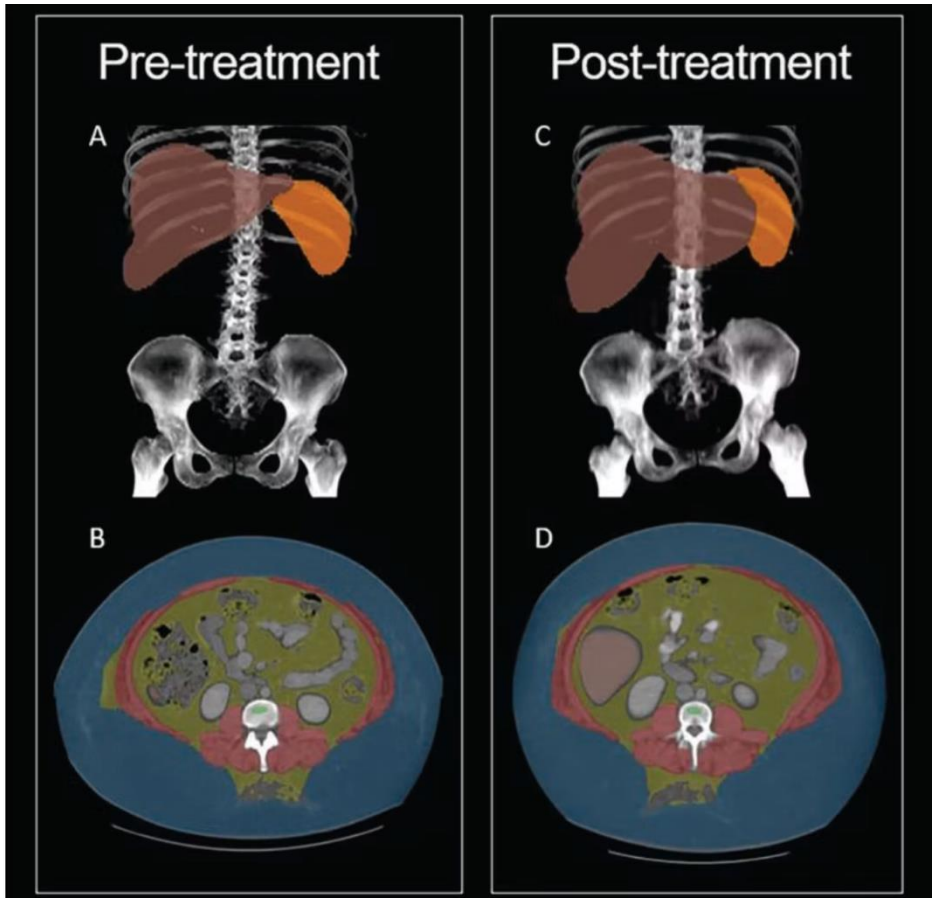
Source deck citations: semaglutide CT PMID 39230989 · 2026 review PMID 41996180

Imaging reveals the quality of weight loss

The scale shows how much was lost; imaging shows what was lost.

- Fat phenotype: visceral, subcutaneous, hepatic and ectopic fat.
- Muscle phenotype: volume, lean mass, myosteatosis and muscle fat fraction, sarcopenia.
- Pair morphology with strength and function; large weight loss can include lean-tissue loss.

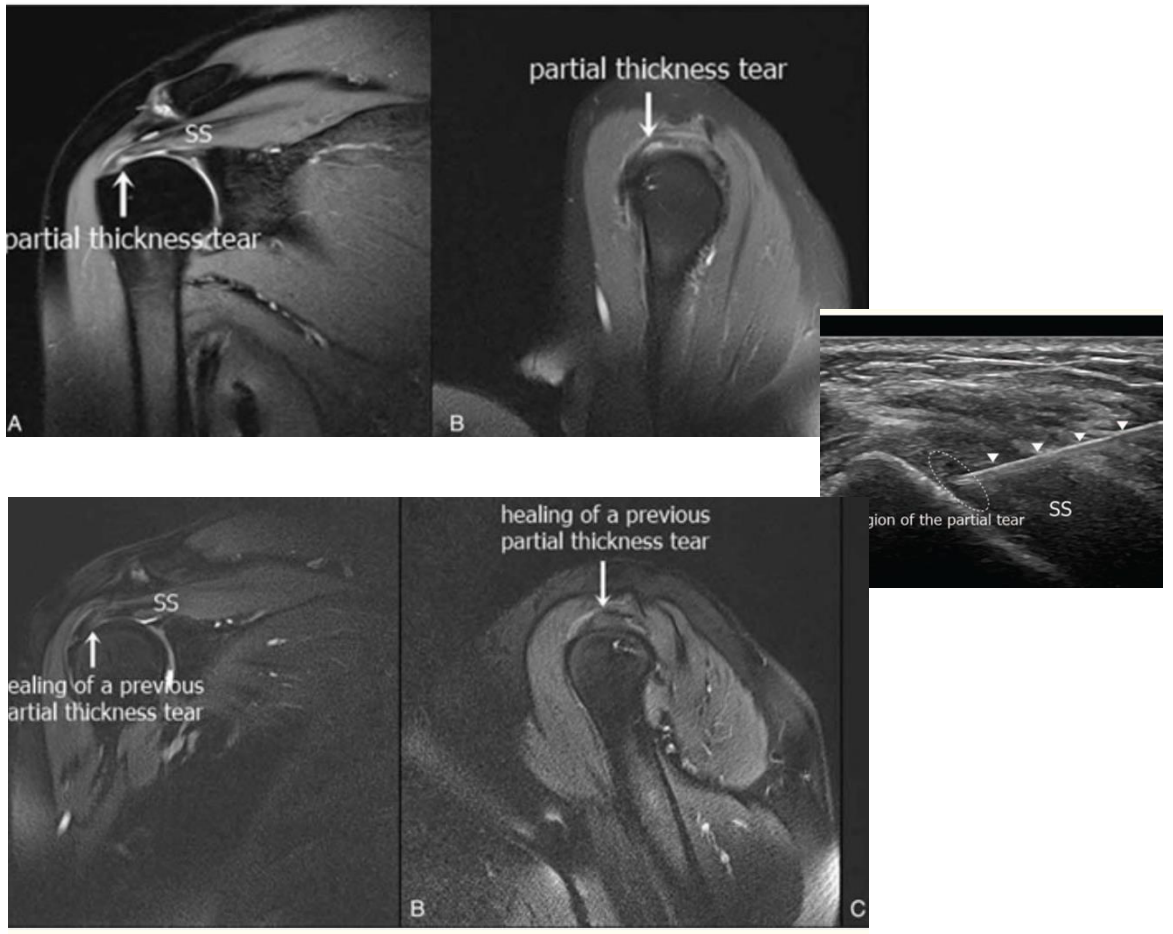
Body Comp Segmentation with MPR reformats.
Semaglutide, quit rx. AJR, ref Sept. 10, 2026 (auntminnie site)



Regeneration claims (BPC-157, TB-500) would benefit from further Imaging Confirmatory evidence

Symptom improvement alone does not demonstrate tissue regeneration.

- Potential endpoints: tendon morphology, muscle volume, cartilage imaging, marrow edema and healing.
- Human efficacy data for popular regenerative peptides remain sparse.
- Imaging can be an objective research platform to become clinical monitoring.
- U/S guided collagen peptide injection has shown structural resolution / improvement



BPC-157 human safety pilot PMID 40131143 · Source deck notes no robust human MRI regeneration evidence

CLINICAL EXAMPLE, Medicine (Baltimore)
. 2020 Dec 4;99(49):e23498. doi: 10.1097/MD.0000000000023498

LONGITUDINAL MEASUREMENT

Imaging can measure biological response over time

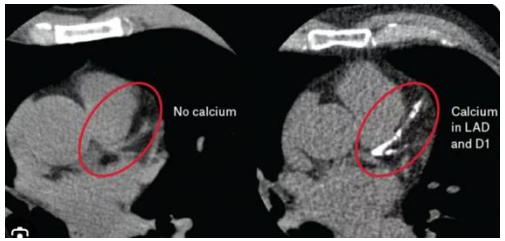
RISK / BASELINE → IMAGING PHENOTYPE → INTERVENTION → FOLLOW-UP → MEASURABLE CHANGE → CLINICAL ACTION

The measurement only matters when it changes clinical understanding or action.

Use a tiered framework for peptide-era imaging

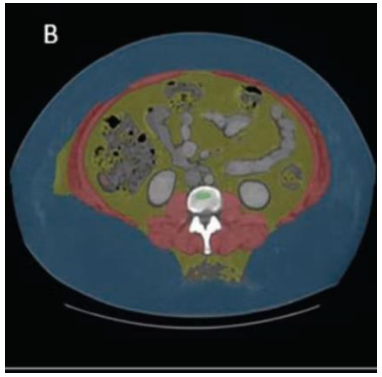
ESTABLISHED

Use imaging when it is part of accepted treatment selection or safety monitoring.
Consider using it as baseline.



EMERGING

Quantify body composition and organ fat during major metabolic change; connect imaging to function.



INVESTIGATIONAL

Define the hypothesis and imaging endpoint before treatment; do not overstate biomarker change.

The strength of the claim must match the strength of the evidence.

The credible future is not “scan everyone”

RISK FACTORS → SUBCLINICAL CHANGE → IMAGING PHENOTYPE → PRECLINICAL DISEASE → SYMPTOMS

Who to scan • what to scan • when to repeat • what action follows

PRACTICE

Ask five questions before every preventive scan

01 What is this person's pre-test risk?

02 What clinically meaningful condition am I trying to identify?

03 What decision changes if the result is positive—or negative?

04 What is the pathway for an indeterminate finding?

05 Is this established screening, risk stratification or an emerging application?

SYNTHESIS

Move from screening to a longitudinal phenotype of health

TRADITIONAL SCREENING	PREVENTIVE IMAGING	PHENOTYPE OF HEALTH
Is a specific disease present?	What clinically important risk or early disease can we identify?	What does this person's health look like today—and what can we act on?

- **TECHNOLOGICAL ADVANCES ARE MAKING WBMRI AND OTHER PROCEDURES MUCH MORE ACCESSIBLE**
- **AS IN OTHER DISCIPLINES, TECHNOLOGY ADVANCING FASTER THAN WE CAN ABSORB AND IMPLEMENT**
- **AI ASSISTANCE MAY PROVE USEFUL IN RESEARCHING AND HELPING IN THE APPROPIATE INTEGRATION OF THESE NEW TECHNOLOGIES**

- **ONLY THE COMBINATION WITH THE APPROPRIATE COORDINATION WITH CLINICAL COLLEAGUES DOES IT MAKE SENSE TO PURSUE THESE INITIATIVES**

THANK YOU

LIVE LONGER. LIVE BETTER. MEASURE BOTH.