MobileREMS

by Longevia

Echolight REMS®

A Clinical Reference

For Healthcare Providers

Prepared by

Alexandra Kusherets

Certified Echolight REMS® Operator, Longevia Health Center

Gig Harbor, Washington · June 2026 · Version 1.2

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> Understanding bone health is complicated, and the tools used to measure it are still catching up. There is no single scan that sees everything, only a set of tools, each revealing a different part of the picture. REMS® is one of those tools — a different kind of input that adds a structural reading density alone cannot provide. This reference reviews what REMS® measures, the evidence behind it, and the patient populations where the clinical literature supports its use.

The Bone Health Workup and Where REMS® Fits

Bone health assessment is not a single test. It is a workup, assembled by a clinician, drawn from several distinct inputs that each reveal something the others do not.

DEXA has been the standard for forty years. It measures areal bone mineral density in two dimensions and produces the T-score framework that anchors current osteoporosis diagnosis. Standard, however, does not mean complete. DEXA's reading can be influenced by body size, positioning, soft-tissue changes, and the degenerative changes that accumulate with age. Some DEXA machines add a trabecular bone score (TBS), a pixel-based estimate of spinal microarchitecture derived from the same image. Useful, still X-ray, and still an estimate drawn from a 2D reading.

Bone turnover markers, measured in serum or urine, show what the bones are doing in real time. Calcium, vitamin D, parathyroid hormone, and related metabolic inputs add context. Genetic and family-history factors round out the risk picture. None of these tests, individually, holds the full clinical answer.

REMS® is a different kind of input. It is a radiofrequency-based ultrasound technology that produces both a density reading and a structural assessment of the bone itself, derived from how the bone reflects the signal rather than estimated from population averages. It also produces a Fragility Score, a 7-tier microarchitectural risk classification with an associated 5-year fracture probability. Where DEXA reads density, REMS® reads density and structure, on the same scan, without radiation.

> The value is not one perfect scan. It is the right combination, assembled by a provider. REMS® is a layer that helps complete that picture.

This reference describes what REMS® measures, the peer-reviewed evidence behind those measurements, and the patient populations where the literature supports its use. Clinical interpretation, integration with other inputs, and treatment decisions remain with the referring or treating clinician.

What REMS® Is

In the four decades since DEXA became the bone density standard, the dominant tool of the bone health workup has measured one parameter: areal mineral content in two dimensions. REMS® adds another. It is the only radiation-free, validated technology that measures both bone density and bone quality on the same scan, and that produces a 5-year fracture risk score derived from the bone's own microarchitectural response. The full technical name, Radiofrequency Echographic Multi-Spectrometry, is FDA-cleared (Class II), CE-marked, and supported by more than 30 peer-reviewed studies representing over 15,000 patients.

How the Technology Works

A standard B-mode ultrasound transducer is positioned transabdominally over the lumbar vertebrae (L1–L4) and laterally over the proximal femur at the femoral neck. The device acquires both conventional ultrasound images and the underlying raw radiofrequency signals from the bone interfaces. Proprietary algorithms then compare each patient's spectral pattern against age- and sex-matched reference models.

Each lumbar acquisition analyzes approximately 1,300 individual ultrasound frames against 256 spectral reference models, the depth of analysis that produces the sub-1% precision documented in the literature. No ionizing radiation. No contrast. No medication adjustment. The full bilateral acquisition takes approximately 15 minutes; total appointment time is approximately 30 to 45 minutes.

What a Single Scan Produces

- Bone mineral density (BMD) with T-score and Z-score at the lumbar spine and femoral neck, directly comparable to DEXA output.
- **Fragility Score:** a REMS®-specific quality-of-bone metric expressed as a 7-tier risk class (R1 through R7) with an associated 5-year fracture probability. Independent of density; reflects microarchitectural integrity derived from the bone's own ultrasound response.
- Body composition module: fat mass, fat-free mass, visceral fat estimate, basal metabolic rate, and longitudinal tracking, derived from the same lumbar acquisition.
- A PDF clinical report formatted for medical record integration, delivered the same day.

> **REMS® at a Glance**
>
> - Radiation-free — safe for pregnancy, lactation, and repeat measurement at any age.
> - Short-term monitoring — 6-month intervals supported by sub-1% precision (LSC 0.88–1.05%).
> - Density and bone quality — the Fragility Score adds a structural input independent of T-score.
> - Same-day report — delivered the day of the scan, formatted for medical record integration.
> - 5-year fracture risk score — calibrated for the clinically actionable monitoring horizon.

What DEXA Measures and What REMS® Adds

DEXA has anchored bone density diagnostics since the late 1980s. It is the standard because for nearly four decades, nothing else existed at clinical scale. Its strengths are well established. Its design constraints, formed by the technology available at the time of its development, are equally well documented in the literature.

What DEXA Measures Well

- Areal bone mineral density at the lumbar spine, hip, and forearm, with the established T-score framework that drives current diagnostic criteria for osteoporosis.
- Longitudinal change in density over multi-year intervals, where the precision profile (LSC 4–5%) supports confident detection of change at the 24 month cadence.
- Integration with FRAX and ISCD treatment algorithms that have been built around its output for decades.
- Trabecular Bone Score (TBS) as an optional add-on, where supported, providing a pixel-grayscale-derived estimate of spinal microarchitecture from the same lumbar DEXA image. TBS is FDA-cleared, ISCD-recognized, and can adjust FRAX risk estimates.

DEXA Design Constraints

- Ionizing radiation that contraindicates use in pregnancy and lactation and limits repeat measurement in patients with significant prior radiation exposure.
- Precision of 4–5% Least Significant Change at the lumbar spine, which restricts confident detection of change to 24 month intervals.
- Density measurement only. Two patients with identical T-scores can have meaningfully different fracture risk, because density does not capture microarchitectural structure.
- Vulnerability to artifact from aortic vascular calcification, vertebral degenerative changes, surgical hardware, and severe scoliosis at the lumbar spine.
- Reimbursement intervals (every 24 months under Medicare and most commercial payers) that align with the precision profile but may not match clinical need for monitoring.
- Fixed-facility delivery, patients must travel to a hospital or imaging center.

What REMS® Adds

REMS® is a different kind of tool, designed to address specific clinical questions DEXA was not built to answer. Same anatomical sites, same T-score framework, same diagnostic categories. The differences are not improvements on DEXA's strengths. They are additions where DEXA's design did not include the capability.

- No ionizing radiation, which permits use in pregnancy, lactation, and frequent repeat measurement across the lifespan.
- Sub-1% LSC, which supports detection of change at six-month intervals where the clinical question is whether an intervention is producing measurable structural response.
- A structural reading of the bone, the Fragility Score, derived from the bone's own radiofrequency response rather than estimated from population averages or pixel-based image analysis.

- Mobile delivery, which allows scans to be performed at the partner clinic rather than at an imaging center and remote locations.

These are differences in capability, not statements about which technology is clinically superior. DEXA remains the appropriate referral in many clinical contexts and the foundation of current treatment algorithms. Where TBS is available, it adds a pixel-derived structural estimate to the DEXA image.

REMS® differs in that its structural reading is derived from the bone's own acoustic response to radiofrequency ultrasound, a different signal source, captured in a single radiation-free session. The two structural inputs are complementary rather than equivalent.

Clinical Evidence

The clinical case for REMS® rests on three independently validated claims: that its diagnostic output is in close agreement with DEXA, that its precision profile supports short-term monitoring of treatment response, and that the REMS®-derived Fragility Score adds an independent structural input to the bone health workup.

1. Diagnostic Agreement with DEXA

The largest validation study to date (Cortet 2021) enrolled 4,307 women aged 30 to 90 across four European countries. Both lumbar spine and femoral neck were scanned by both modalities under standardized protocols.

Parameter	REMS® Lumbar Spine	REMS® Femoral Neck
Sensitivity vs. DEXA	90.9%	90.4%
Specificity vs. DEXA	95.1%	95.5%
BMD correlation (r)	0.94	0.93
Diagnostic agreement (0.3 T-score tolerance)	97.4%	98.0%

Original Italian multicenter validation (Di Paola 2018) (n=1,914) produced concordant figures: sensitivity 91.5%–91.7%, specificity 91.8%–92.0%.

Clinical implication. When REMS® classifies a patient as osteoporotic, osteopenic, or normal, the diagnostic category aligns with what DEXA would have produced more than 90 percent of the time, and more than 97 percent of the time within the 0.3 T-score margin ISCD treats as clinically equivalent. REMS® results can be interpreted within the same T-score framework physicians already use for DEXA.

2. Precision and Short-Term Monitoring

Precision determines what magnitude of change between two scans can be confidently attributed to a real biological signal rather than measurement variation. It governs how soon after baseline a follow-up scan becomes clinically meaningful. Three independent research groups have measured REMS® precision in vivo (Di Paola 2018); Lalli 2022; Messina 2023.

Parameter	REMS® Lumbar	REMS® Femur	DEXA Reference
Intra-operator precision (RMS-CV)	0.38%	0.32%	1.78–2.02%
Least Significant Change (LSC)	1.05%	0.88%	4.07–5.60%
Inter-operator repeatability	0.54%	0.48%	Not reported

DEXA precision range from Osteoporos Int 2005 and Ann Rheum Dis 2004 reference cohorts.

Clinical implication. REMS® LSC of approximately 1% at both anatomical sites supports confident detection of change at six-month intervals. DEXA LSC of 4–5% typically requires 18 to 24 months between scans for confident detection of change. Where the clinical question is whether an intervention is producing measurable structural response on a six-month timeline, REMS® provides a precision profile that allows that question to be answered within the intervention window. Where the clinical question is longer-term density trajectory aligned with current reimbursement cycles, DEXA's precision profile is appropriate to that timeline.

3. The Fragility Score and Fracture Risk Prediction

The Fragility Score is a REMS®-derived metric reflecting bone microarchitectural integrity, independent of density. In a five-year prospective cohort of 1,989 patients (Pisani 2023), the Fragility Score produced an area under the ROC curve of 0.811 for incident fragility fracture in women and 0.780 in men. DEXA T-score AUC in the same cohort ranged from 0.472 to 0.709 across sites and genders.

The report presents the Fragility Score as a 7-tier risk class, R1 through R7, each tier associated with a calculated 5-year fracture probability. Conventional FRAX provides risk over a 10-year window; the REMS® Fragility Score is calibrated for a 5-year horizon.

The Fragility Score differs from TBS in deriving its structural reading from the bone's acoustic response rather than from pixel-grayscale analysis of an X-ray image. The two are complementary structural inputs with distinct validation bases.

Clinical implication. In patients whose DEXA T-score sits in the osteopenic or borderline range, where treatment decisions are clinically ambiguous, the Fragility Score provides an additional structural input that may reclassify a subset of patients into higher or lower risk strata than density alone would suggest. The Fragility Score is not integrated into FRAX or major treatment guidelines and should be used as a supplementary input alongside conventional risk stratification, not as a replacement.

Patient Populations Where REMS® Is Clinically Indicated

REMS® is supported by the peer-reviewed literature for a broad clinical patient base. The table below summarizes the major indications, grouped by clinical category. Most practices find their actual REMS® patient flow distributed across many of these categories. The presence of a category in this table reflects published literature supporting REMS® use in that population; clinical interpretation and integration with other inputs remain the responsibility of the referring or treating clinician.

Category	Patient Population / Clinical Context	Supporting Evidence
SCREENING & STANDARD INDICATIONS		
Standard screening	Postmenopausal women aged 65+; men aged 70+; earlier with risk factors. Adults with prior fragility fracture. Adults with significant family history of osteoporosis.	ISCD 2023; Zambito 2025
Hormonal life-stage	Perimenopausal and menopausal women, particularly during the 3-year window around the final menstrual period when bone loss is most rapid. Surgical menopause. Premature ovarian insufficiency. Women on or discontinuing estrogen replacement. Andropausal men on or considering testosterone replacement.	Zambito 2025; ISCD 2023
Optimization & baseline	Adults seeking baseline assessment before hormone, peptide, GLP-1, or longevity protocols. Athletes and high-performers monitoring skeletal load capacity. Patients pursuing proactive prevention outside conventional screening criteria.	Pisani 2023
TREATMENT-INDUCED & MEDICATION-RELATED		
Cancer treatment	Breast cancer on aromatase inhibitor therapy. Prostate cancer on androgen deprivation therapy. Patients on chronic glucocorticoids for hematologic malignancy. Pediatric cancer survivors. Post-bone-marrow-transplant patients.	Ciardo 2020; Quarta 2020; Forcignanò 2020; IOF 2025
GLP-1 receptor agonists	Patients on semaglutide, tirzepatide, or related GLP-1 RAs. Hansen 2024 documented 2.6% hip BMD and 2.1% lumbar spine BMD reduction over 52 weeks of semaglutide therapy in adults with elevated fracture risk. The SURMOUNT-1 DXA substudy on tirzepatide found approximately 25% of total weight lost was lean mass. Baseline and follow-up monitoring increasingly discussed in the literature, particularly for postmenopausal women and adults over 50.	Hansen 2024; Look 2025 (SURMOUNT-1)
Medication-induced	Long-term glucocorticoids, bone loss visible within 3 to 6 months of initiation. Chronic PPI use. Long-term SSRI use. Anticonvulsants. Depo-Provera (especially 5+	ACR 2017; Zambito 2025

Category	Patient Population / Clinical Context	Supporting Evidence
	years). GnRH agonists for endometriosis or infertility treatment.	
Treatment monitoring	Patients receiving bone-active therapy where 6-month assessment of response is clinically valuable: bisphosphonates, denosumab, romosozumab, teriparatide. Patients on integrative or lifestyle protocols where structural response measurement on a six-month timeline is the clinical endpoint.	Ciardo 2020; Messina 2023; Fuggle 2024
CHRONIC CONDITIONS & DISEASE-DRIVEN		
Endocrine & metabolic	Type 2 diabetes, where REMS® has classified more patients as osteoporotic than DEXA (47% vs 28% in one cohort), consistent with the diabetic bone-quality paradox documented in the literature. Type 1 diabetes. Acromegaly. Hyperparathyroidism. Hyperthyroidism.	Caffarelli 2022; Rolla 2020
Renal	Chronic kidney disease, particularly with vascular calcification that confounds DEXA at the lumbar spine. Peritoneal dialysis patients. Kidney transplant recipients.	Fassio 2023; Fassio 2024
Autoimmune & inflammatory	Rheumatoid arthritis. Systemic lupus erythematosus, including premenopausal patients whose youth does not protect against autoimmune-driven bone loss. Inflammatory bowel disease with steroid exposure. Ankylosing spondylitis. Psoriatic arthritis. Patients on Low Dose Naltrexone protocols with intermittent steroid exposure.	Fuggle 2024
Malabsorption	Celiac disease. Inflammatory bowel disease. History of bariatric surgery, Roux-en-Y and sleeve gastrectomy populations have documented accelerated bone loss.	Caffarelli 2022
SPECIAL POPULATIONS & DEXA LIMITATIONS		
Reproductive	Pregnancy and breastfeeding, where REMS® provides the non-ionizing assessment DEXA cannot. Women planning pregnancy seeking baseline. Postpartum recovery, particularly after multiple pregnancies or extended lactation.	Degennaro 2021; Ramirez 2024; Arechavaleta 2025
Eating disorder recovery	Active and recovering anorexia nervosa, where REMS® has been validated for serial monitoring during recovery, including during fertile age and pregnancy when DEXA is contraindicated.	Caffarelli 2022
DEXA-confounded anatomy	Significant aortic vascular calcification, which overestimates lumbar DEXA. Severe degenerative changes at L1–L4. Spinal hardware. Osteoarthritis of the lumbar spine. Severe scoliosis.	Caffarelli 2022; Fassio 2023

Indication categories adapted from Zambito 2025 practice parameters and supporting peer-reviewed literature.

The Clinical Report

Each REMS® scan produces a clinical report containing:

- BMD T-score and Z-score at lumbar spine (L1–L4) and femoral neck, interpretable using the same framework as DEXA.
- Fragility Score with 7-tier risk classification (R1–R7) and 5-year fracture probability.
- Body composition module, fat mass, fat-free mass, visceral fat estimate, basal metabolic rate, body age.
- Longitudinal tracking display for patients with repeat scans, showing trend across timepoints.
- A site-specific clinical summary with measurement values, reference ranges, and a graphical risk display.

A sample REMS® report is available upon request. Reports are formatted for medical record integration and are delivered to the patient and to the referring or partner clinician on the day of the scan.

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