REMS – what is it and should I have one?

The following is a narrative summary about REMS– what it is, strengths and limitations, and ongoing controversy about it. It's about 900 words - if you would rather cut to the chase, there is a dot point summary at the end. (Prepared 9 Feb 2026)

Radiofrequency Echographic Multi-Spectrometry (REMS) is an ultrasound-based technology designed to estimate bone mineral density (BMD) and aspects of skeletal fragility at the lumbar spine and femoral neck. Unlike DXA, which measures photon attenuation (using low-dose ionising radiation) as a direct physical proxy for mineral content, REMS analyses radiofrequency ultrasound signals reflected from bone and surrounding tissues. Spectral patterns extracted from these signals are compared with reference databases, and the resulting outputs — BMD, T-scores, and fragility-related indices — are generated through proprietary algorithms that incorporate patient characteristics such as age, sex and body mass index (BMI). As a result, REMS is a model-based densitometry calculation, not a direct measurement of BMD.

The most obvious **benefit of REMS** is the absence of ionising radiation, which increases the safety of frequent monitoring and use during pregnancy. REMS devices are compact and portable, making them attractive for point-of-care assessment (i.e. the doctor's office). REMS BMD has been proposed to be less affected by degenerative spinal changes, vascular calcifications, or other artefacts that can spuriously elevate DXA-derived BMD. Early validation studies showed strong correlations between REMS-derived BMD and DXA BMD in selected cohorts, although the implications of this observation are unclear when REMS supporters simultaneously argue that REMS-derived BMD is a *superior* index of bone health than DXA-derived BMD (which sounds a bit like wanting their cake – saying REMS BMD is the same as DXA BMD – and eating it – arguing that DXA BMD is flawed.) REMS measures appear to have reasonable sensitivity and specificity for identifying osteoporosis. An additional proprietary "fragility score," is intended to capture aspects of bone quality beyond density alone, although its independent clinical value has not been fully validated.

There are several **limitations and uncertainties about REMS**. The proposed advantage of frequent monitoring diminishes in the knowledge that bone adapts very slowly to most interventions so frequent monitoring may not detect therapy-related change. REMS scanning also requires considerable training for technical competence and involves the use of ultrasound gel and exposure of bodily regions for scanning that can challenge modesty. Normative data is limited in diverse ethnic groups and extreme body compositions, and some studies report reduced accuracy or feasibility in severe obesity. Agreement with DXA varies by disease population and clinical context, with only moderate concordance in certain chronic disease cohorts. The greatest challenge, however, appears to be that REMS integrates demographic data directly into its calculation of BMD. In fact, the dependence of REMS BMD on age and BMI has become a central methodological concern — particularly when the technology is used for longitudinal monitoring or intervention research.

This concern is the focus of two recent publications which bring into question exactly what REMS measures. A 2025 editorial by Pocock and Chan (1) suggested that REMS BMD is almost entirely influenced by demographic inputs rather than the bone signal. They found that altering age and weight for a patient could materially change REMS-derived BMD, suggesting its performance in fracture prediction derives from variables already known to be strong predictors of fracture (age and weight). In practical terms, this means that a patient could receive one BMD score if their correct demographics are used, but if a mistake is made in entering age or weight, the same person scanned on the same day will receive a completely different BMD score. This effect is clearly of concern from the standpoint of bone assessment and monitoring. Of course, a device should not be judged on the risk of technician error (although we know that is disturbingly prevalent in clinical settings), but people can experience dramatic weight changes in relatively short periods which would thereby influence their BMD score in the absence of true BMD change. DXA-derived BMD is independent of demographics such as age or BMI.

Bobelyak and colleagues (2) extended this debate by examining REMS data in a hip replacement population. Like Pocock and Chan, they reported that statistical modelling indicated a large proportion of variance in REMS-derived femoral-neck BMD could be explained by demographic characteristics — notably age, sex and BMI — rather than by bone changes alone.

Proponents of REMS (3) responded by claiming the ultrasound signal still contributes substantially to the final REMS BMD estimate after algorithm processing, but the evidence remains unclear. They argue that REMS BMD has nevertheless demonstrated acceptable performance in fracture prediction in several observational studies. As it is well known that age, sex and body mass alone are strongly predictive of osteoporosis, this is not in fact a strong argument for REMS BMD.

Clearly the debate is ongoing.

From a practical standpoint, REMS may be valuable for screening patients who cannot easily undergo DXA scanning. However, caution is warranted using REMS as a primary outcome in longitudinal research trials (especially in populations with fluctuating weight or ageing effects). REMS outputs should be interpreted as hybrid measures reflecting both biological ultrasound signal and algorithmic modelling. Understanding this distinction is essential to avoid over-interpreting small changes or attributing fracture discrimination solely to skeletal measurement when demographic influences may also play a substantial role.

In summary, REMS is a portable and radiation-free modality for bone assessment with potential for clinical application, but important questions remain about demographic confounding and algorithm dependence, reinforcing the need for transparent validation studies and careful interpretation before considering integrating REMS into clinical decision-making or research design.

In short:

- **REMS**: ultrasound-based, model-derived method estimating BMD and fragility from spectral signals plus demographic inputs (age, sex, BMI).
- **Strengths**: no radiation, portable, clinically relevant measurement sites, potentially less affected by degenerative artefacts; may be useful for frequent monitoring.
- **Limitations**: algorithm-dependent outputs, strongly dependent on age, sex and BMI, variable agreement with DXA, limited validation across populations, sensitivity to body composition.
- **Chan findings**: demographic variables materially influence calculated BMD; risk of circularity in fracture prediction.
- **Bobelyak hip analyses**: large proportion of femoral-neck REMS variance explained by demographics, raising concern that some fracture discrimination reflects modelling rather than independent skeletal signal.

References:

1. Pocock N, Chan D. Is REMS-BMD truly a measured parameter? A call for transparency and technical clarification. *Osteoporosis International.* 2025. doi:10.1007/s00198-025-07699-4
2. Bobelyak M, Vaculik J, Stepan JJ. Bone mineral density assessment using radiofrequency echographic multispectrometry (REMS) in patients before and after total hip replacement. *Osteoporosis International.* 2025. doi:10.1007/s00198-025-07685-w
3. Al-Daghri N, et al. Response to Bobelyak et al. and Pocock & Chan regarding REMS-BMD methodology and interpretation. *Osteoporosis International.* 2025. doi:10.1007/s00198-025-07817-2