EE708

# Clinical and Economic Outcomes of Whole-Body MRI Screening: A US Employer Perspective

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## Introduction & Objective

- Chronic diseases impose substantial clinical and economic burdens in the United States, yet traditional screening remains fragmented and organ-specific.[1-6]
- Whole-body magnetic resonance imaging (WB-MRI) is a noninvasive imaging approach that can evaluate multiple organ systems in a single session without ionizing radiation or intravenous contrast and may identify imaging-detectable conditions at earlier, more treatable stages than under usual care.[7]
- Earlier detection may shift disease diagnoses to earlier stages, reducing downstream treatment burden, healthcare costs, and productivity losses;[8,9] however, broader screening requires upfront investment in screening and diagnostic workup.
- **Objective:** This study estimated the health outcomes and return on investment (ROI) associated with adding WB-MRI to usual-care screening for 14 solid tumor types and metabolic dysfunction-associated steatotic liver disease (MASLD), from a US employer perspective.

## Methods

### Overview

- A simulation model compared WB-MRI plus usual care with usual care alone over a 10-year time horizon in a hypothetical 100,000-person US employer population. The primary scenario evaluated one-time WB-MRI among employees aged ≥50 years.

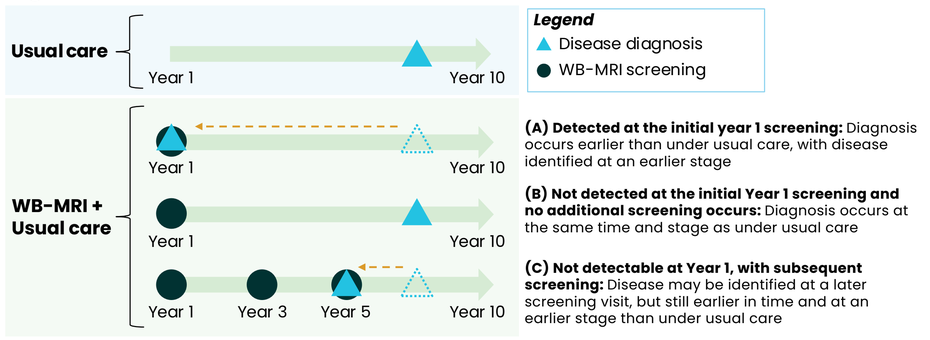
### Model Structure

- The model included 14 solid tumor types (lung/bronchus, pancreas, liver/intrahepatic bile duct, breast, esophagus, head/neck, stomach, ovarian, kidney/renal pelvis, prostate, bowel, uterus, cervix, and urothelial cancer) and MASLD.
- The model combined a pre-diagnosis state-transition component with a post-diagnosis component (Figure 1). The modeled clinical benefit of WB-MRI was driven by earlier detection, which shifted the timing and stage distribution of diagnoses, with health outcomes and costs determined by stage at diagnosis. Stage-shift probabilities incorporated WB-MRI test performance and disease-specific dwell times.
- After diagnosis, cancer outcomes were modeled using disease-, age-, sex-, and stage-specific survival and costs; MASLD outcomes were modeled using a Markov component reflecting progression across noncirrhotic and cirrhotic states.

### Outcomes and Analyses

- Health outcomes included late-stage diagnoses avoided (stage III/IV cancer or cirrhosis) and life-years (LYs). ROI was defined as disease-related direct and indirect cost offsets divided by incremental screening and diagnostic workup costs. An ROI >100% indicated that for every $1 invested in screening and workup costs, more than $1 was returned in healthcare and productivity savings, yielding net savings.
- Scenario analyses evaluated alternative populations and screening frequencies. One-way sensitivity analyses varied screening frequency, disease incidence, test performance, screening/workup costs, disease-related healthcare costs, and indirect costs.

### Figure 1. Overview of model structure




## Results

### Base-case scenario: one-time screening among employees aged ≥50 years

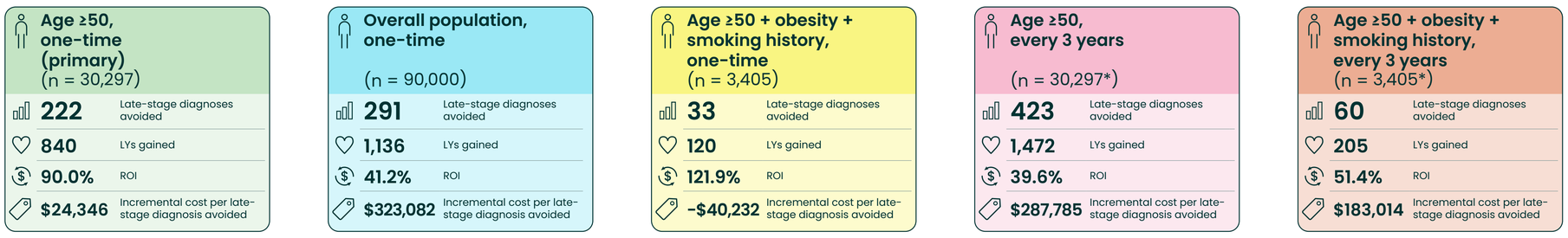
- In the base-case scenario of one-time WB-MRI screening among employees aged ≥50 years (N = 30,297 screened), WB-MRI plus usual care was estimated to improve health outcomes compared with usual care alone over the 10-year model horizon, generating 840 additional total LYs (Table 1).
- WB-MRI plus usual care was estimated to shift cancer diagnoses toward earlier-stage disease, increasing stage I and II diagnoses by 148 and 8 cases, respectively, while decreasing stage III and IV diagnoses by 45 and 112 cases. Similar shifts were estimated for MASLD; WB-MRI plus usual care shifted 55 cases of compensated cirrhosis and 10 of decompensated cirrhosis to noncirrhotic MASLD compared with usual care alone.
- Overall, WB-MRI plus usual care was estimated to reduce late-stage diagnoses (stage III or IV cancer or cirrhotic MASLD) by 222 cases (a 25.2% reduction) compared with usual care. These shifts corresponded to a mean increase of 3.70 LYs and 3.96 LYs per patient with a shifted cancer and MASLD diagnosis, respectively.
- WB-MRI plus usual care yielded an incremental cost of $5.4 million across the 100,000-person employer population compared with usual care alone, primarily driven by screening and diagnostic workup costs; this difference was largely offset by reductions in disease-related healthcare costs and indirect costs (Table 1).
- Disease-related direct and indirect cost offsets recovered 90.0% of the incremental screening and diagnostic workup investment for WB-MRI plus usual care, equivalent to $0.90 per $1 invested. The incremental cost per late-stage diagnosis avoided was $24,346.

### Table 1. Summary of base-case results among patients aged 50+ years (one-time screening)

| Clinical outcomes | Usual care | WB-MRI + usual care | Difference |
|---|---|---|---|
| **Total life years** | 286,777 | 287,617 | +840 |
| **Total number of cancers diagnosed** | 2,108 | 2,108 | 0 |
| Stage I | 895 | 1,043 | +148 |
| Stage II | 403 | 411 | +8 |
| Stage III | 354 | 309 | -45 |
| Stage IV | 457 | 345 | -112 |
| **Total number of MASLD diagnosed** | 12,260 | 12,260 | 0 |
| Non-cirrhotic | 12,188 | 12,254 | +66 |
| Cirrhotic (compensated) | 59 | 4 | -55 |
| Cirrhotic (decompensated) | 12 | 2 | -10 |
| Death (post-MASLD diagnosis) | 0 | 0 | 0 |
| Cancer (post-MASLD diagnosis) | 0 | 0 | 0 |
| **Total number of late-stage diagnoses** | 882 | 660 | -222 (-25.2%) |
| **Economic outcomes** | **Usual care** | **WB-MRI + usual care** | **Difference** |
| **Total costs** | $837.4M | $842.8M | +$5.4M |
| Screening costs | $0M | $43.6M | +$43.6M |
| Diagnostic workup costs | $1.1M | $11.4M | $10.3M |
| Disease-related healthcare costs | $581.8M | $534.6M | -$47.3M |
| Indirect costs† | $254.4M | $253.3M | -$1.2M |
| **Incremental cost per late-stage disease avoided** | - | - | $24,346 |
| **ROI = Return / Investment** | - | - | 90.0% |

**Abbreviations:** MASLD, metabolic dysfunction-associated steatotic liver disease; ROI, return-on-investment; WB-MRI, whole-body magnetic resonance imaging.
†Indirect costs reflected employer-relevant productivity losses in the first year after diagnosis. For cancer, these included absenteeism, short- and long-term disability, and friction costs. For MASLD, they included absenteeism and presenteeism.

### Figure 2. Selected scenario results




Population size shown; repeated screening occurs over the 10-year horizon. Abbreviations: LY, life-year; ROI, return on investment.

### Population targeting and screening frequency

- Across modeled scenarios, broader screening produced larger absolute clinical gains, whereas targeting higher-risk employees improved economic efficiency (Figure 2).
- One-time screening of all eligible employees generated more absolute clinical benefit but lower cost recovery (ROI: 41.2%; $0.41 per $1 invested), whereas one-time screening among employees aged ≥50 years with obesity and a current/former smoking history yielded cost offsets exceeding incremental investment (ROI: 121.9%; $1.22 per $1 invested).
- More frequent screening increased clinical gains but reduced cost recovery. Among employees aged ≥50 years, screening every 3 years increased late-stage diagnoses avoided from 222 to 423 and LYs gained from 840 to 1,472, while ROI decreased from 90.0% to 39.6% ($0.90 to $0.40 per $1 invested).

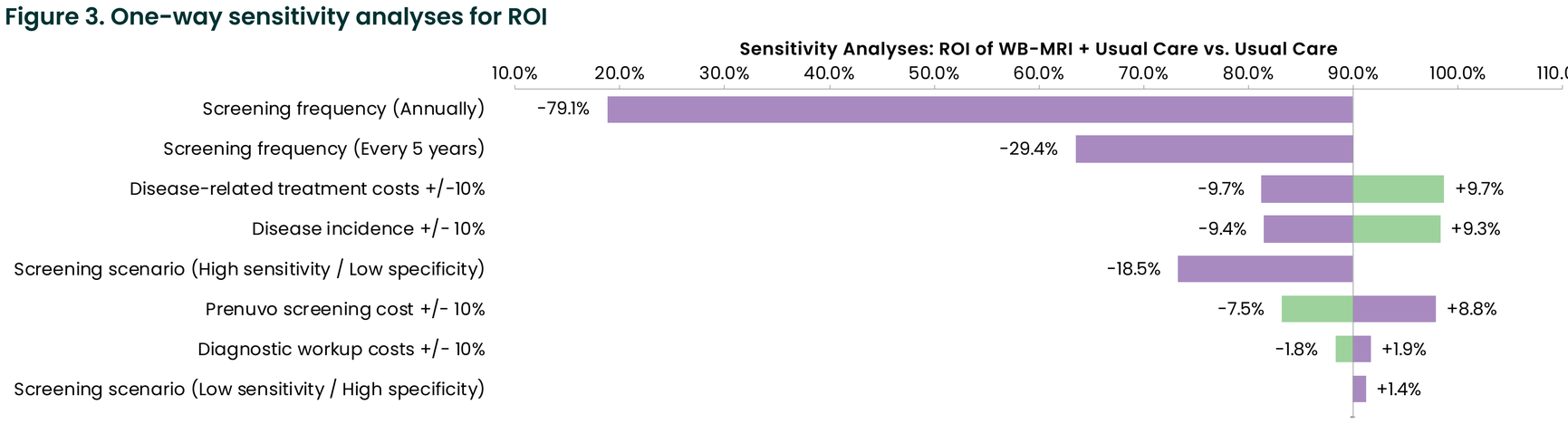
### Sensitivity analyses

- Results were most sensitive to screening frequency, followed by disease-related healthcare costs, disease incidence, and WB-MRI sensitivity (Figure 3). Diagnostic workup costs and indirect costs had smaller effects on ROI.

## Key Takeaway: Screening Strategy Shapes the Clinical–Economic Trade-off

- Broader or more frequent screening produced greater modeled clinical gains, whereas targeting higher-risk employees yielded higher ROI. These results provide employers with a basis for weighing clinical impact against economic return when designing screening programs.

### Figure 3. One-way sensitivity analyses for ROI




**Abbreviations:** ROI, return on investment; WB-MRI, whole-body magnetic resonance imaging. Base-case ROI = 90.0%.

## Limitations

- Results are model-based and depend on assumptions regarding stage/time shift, disease-specific dwell times, WB-MRI test performance, downstream costs, and the relationship between earlier diagnosis and survival.
- WB-MRI sensitivity and specificity inputs were based on published literature where available; for some conditions, data were extrapolated from disease-specific imaging studies, enriched clinical populations, or non-screening settings.
- The employer perspective and 10-year time horizon may not capture all lifetime benefits or costs, particularly for chronic conditions such as MASLD.
- The model included diagnostic workup costs following positive findings but did not fully capture diagnostic cascades, long-term surveillance, patient burden, overdiagnosis, or benefits from detecting non-modeled actionable conditions.

## Conclusions

- Adding WB-MRI to usual-care screening was estimated to shift imaging-detectable cancers and MASLD toward earlier stages and improve health outcomes in a US employer population over a 10-year time horizon.
- In the base-case scenario, one-time screening among employees aged ≥50 years was estimated to reduce late-stage diagnoses by 25.2%, generate 840 additional LYs, and recover 90.0% of incremental screening and diagnostic workup investment through disease-related cost offsets ($0.90 per $1 invested).
- Economic value was most favorable when screening was targeted to higher-risk employees defined by age, obesity, and smoking history, while more frequent screening produced larger clinical gains at lower cost recovery.
- These findings highlight population risk and screening frequency as key considerations when designing employer-sponsored WB-MRI screening programs.

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