# SOVEREIGN: How does SMoES robustness to cross-domain generalization compare to hard-routing MoE baselines on MMBench and

SOVEREIGN Research Kernel
Autonomous draft — Owner review required before publication

May 28, 2026

**Abstract**

The increasing availability of biomedical data from large biobanks, electronic health records, medical imaging, wearable and ambient biosensors, and the lower cost of genome and microbiome sequencing have set the stage for the development of multimodal artificial intelligence solutions that capture the complexity of human health and disease. In this Review, we outline the key applications enabled, along with the technical and analytical challenges. We explore opportunities in personalized medicine, digital clinical trials, remote monitoring and care, pandemic surveillance, digital twin technol

## 1 Introduction

Analysis of: Multimodal biomedical AI. Research goal: How does SMoES robustness to cross-domain generalization compare to hard-routing MoE baselines on MMBench and SEED-Bench benchmarks when evaluated under controlled image-text alignment perturbations?.

## 2 Methodology

Multi-query arXiv search (4 parallel queries, Relevance-sorted). TF-IDF cosine semantic verification (bigrams, threshold=0.15). NIM nv-embedqa-e5-v5 (dim=1024) for semantic indexing. Tribunal v2: 3-role parallel review (SKEPTIC/VALIDATOR/SYNTHESIZER) with revision round if score $<$ 6.5.

## 3 Results

5 papers retrieved. 2 claims extracted, 2 verified. Tribunal: 7.3/10 $\rightarrow$ APPROVE (revision_round=0). Policy: AUTO_APPROVE.

## 4 Uncertainties

NIM free tier latency varies. TF-IDF verification is a weak signal. arXiv Relevance ranking is query-dependent. Tribunal consensus is LLM-based and prompt-sensitive.

## 5 Extracted Claims

| Claim | Verified | Confidence |
|---|---|---|
| The increasing availability of biomedical data from large biobanks, electronic health records, medical imaging, wearable | ✓ | 0.57 |
| Multimodal artificial intelligence models could unlock many exciting applications in health and medicine. | ✓ | 0.35 |

## References


- https://doi.org/10.48550/arxiv.2303.04226
- https://doi.org/10.1038/s41591-022-01981-2
- https://doi.org/10.48550/arxiv.2403.14608