

**MAIMON RESEARCH LLC**  
**ARTIFICIAL INTELLIGENCE LARGE LANGUAGE  
MODEL INTERROGATION**



**REPRESENTATIONAL MEASUREMENT FAILURE IN  
HEALTH TECHNOLOGY ASSESSMENT**

**UNITED STATES: INVALID MEASUREMENT IN  
HEALTH TECHNOLOGY ASSESSMENT — A  
STRUCTURAL ASSESSMENT OF THE HTA RELATED  
KNOWLEDGE BASE OF THE ROSEMAN UNIVERSITY  
OF HEALTH SCIENCES COLLEGE OF PHARMACY**

**Paul C Langley Ph.D Adjunct Professor, College of Pharmacy, University of  
Minnesota, Minneapolis, MN**

**LOGIT WORKING PAPER No 3043 APRIL 2026**

[www.maimonresearch.com](http://www.maimonresearch.com)

**Tucson AZ**

# FOREWORD

## HEALTH TECHNOLOGY ASSESSMENT: A GLOBAL SYSTEM OF NON-MEASUREMENT

The Roseman University of Health Sciences College of Pharmacy is the principal provider of professional pharmacy education in Nevada and a key contributor to healthcare workforce development in the region. The College offers an accelerated Doctor of Pharmacy (PharmD) program designed to prepare graduates for entry into clinical, community, and institutional practice within a condensed timeframe. Its curriculum integrates biomedical sciences, pharmacotherapy, and extensive experiential learning, enabling students to apply knowledge in real-world healthcare settings early in their training.

A distinctive feature of the College is its mastery-based educational model, where students are required to demonstrate a high level of competency in each subject area before progressing. This approach emphasizes deep understanding, clinical reasoning, and accountability, aligning with the demands of modern pharmacy practice. Students gain hands-on experience through clinical rotations in hospitals, community pharmacies, and other healthcare environments, often working as part of interprofessional teams.

The objective of this assessment is to evaluate whether the HTA-related knowledge base associated with the Roseman University of Health Sciences College of Pharmacy conforms to the axioms of representational measurement required to support valid, empirically evaluable therapy impact claims. Using the 24-item canonical statement framework, the assessment interrogates the extent to which core measurement principles of unidimensionality, invariance, dimensional homogeneity, and the requirement that measurement must precede arithmetic are recognized and applied within teaching, applied research, and the interpretation of HTA constructs. Each statement is assigned an endorsement probability reflecting the degree to which the knowledge base behaves as if the statement were true, with probabilities transformed into normalized logits to provide a structured diagnostic profile. The purpose is to characterize the implicit assumptions embedded in HTA-related content encountered by students and practitioners and to determine whether these assumptions support the development of claims that are credible, replicable, and falsifiable.

The findings indicate a consistent divergence between the axioms of representational measurement and the constructs that underpin conventional HTA practice. Statements reflecting measurement requirements are weakly endorsed, with probabilities generally in the range of 0.05 to 0.30 (normalized logits approximately  $-2.50$  to  $-1.10$ ), indicating that the constraints necessary to support admissible arithmetic are not enforced within the knowledge base. In contrast, statements representing HTA constructs—particularly those relating to utilities, QALYs, ordinal aggregation, and simulation-based outputs—are strongly endorsed, with probabilities of 0.85 to 0.95 (logits approximately  $+1.75$  to  $+2.50$ ). This bifurcation reflects a systematic pattern of measurement inversion, where constructs that do not meet the axioms of measurement are treated as if they were valid measures, while the principles required to establish measurement are weakly recognized. Although there is nominal endorsement of scientific criteria such as falsifiability, this is undermined by the acceptance of model-based outputs as if they were empirically testable. The

resulting profile indicates that the knowledge base cannot support therapy claims that meet the standards required for empirical evaluation.

The starting point is simple and inescapable: *measurement precedes arithmetic*. This principle is not a methodological preference but a logical necessity. One cannot multiply what one has not measured, cannot sum what has no dimensional homogeneity, cannot compare ratios when no ratio scale exists. When HTA multiplies time by utilities to generate QALYs, it is performing arithmetic with numbers that cannot support the operation. When HTA divides cost by QALYs, it is constructing a ratio from quantities that have no ratio properties. When HTA aggregates QALYs across individuals or conditions, it is combining values that do not share a common scale. These practices are not merely suboptimal; they are mathematically impossible.

The modern articulation of this principle can be traced to Stevens' seminal 1946 paper, which introduced the typology of nominal, ordinal, interval, and ratio scales <sup>1</sup>. Stevens made explicit what physicists, engineers, and psychologists already understood: different kinds of numbers permit different kinds of arithmetic. Ordinal scales allow ranking but not addition; interval scales permit addition and subtraction but not multiplication; ratio scales alone support multiplication, division, and the construction of meaningful ratios. Utilities derived from multiattribute preference exercises, such as EQ-5D or HUI, are ordinal preference scores; they do not satisfy the axioms of interval measurement, much less ratio measurement. Yet HTA has, for forty years, treated these utilities as if they were ratio quantities, multiplying them by time to create QALYs and inserting them into models without the slightest recognition that scale properties matter. Stevens' paper should have blocked the development of QALYs and cost-utility analysis entirely. Instead, it was ignored.

The foundational theory that establishes *when* and *whether* a set of numbers can be interpreted as measurements came with the publication of Krantz, Luce, Suppes, and Tversky's *Foundations of Measurement* (1971) <sup>2</sup>. Representational Measurement Theory (RMT) formalized the axioms under which empirical attributes can be mapped to numbers in a way that preserves structure. Measurement, in this framework, is not an act of assigning numbers for convenience, it is the discovery of a lawful relationship between empirical relations and numerical relations. The axioms of additive conjoint measurement, homogeneity, order, and invariance specify exactly when interval scales exist. RMT demonstrated once and for all that measurement is not optional and not a matter of taste: either the axioms hold and measurement is possible, or the axioms fail and measurement is impossible. Every major construct in HTA, utilities, QALYs, DALYs, ICERs, incremental ratios, preference weights, health-state indices, fails these axioms. They lack unidimensionality; they violate independence; they depend on aggregation of heterogeneous attributes; they collapse under the requirements of additive conjoint measurement. Yet HTA proceeded, decade after decade, without any engagement with these axioms, as if the field had collectively decided that measurement theory applied everywhere except in the evaluation of therapies.

Whereas representational measurement theory articulates the axioms for interval measurement, Georg Rasch's 1960 model provides the only scientific method for transforming ordered categorical responses into interval measures for latent traits <sup>3</sup>. Rasch models uniquely satisfy the principles of specific objectivity, sufficiency, unidimensionality, and invariance. For any construct

such as pain, fatigue, depression, mobility, or need, Rasch analysis is the only legitimate means of producing an interval scale from ordinal item responses. Rasch measurement is not an alternative to RMT; it is its operational instantiation. The equivalence of Rasch's axioms and the axioms of representational measurement was demonstrated by Wright, Andrich and others as early as the 1970s. In the latent-trait domain, the very domain where HTA claims to operate; Rasch is the only game in town <sup>4</sup>.

Yet Rasch is effectively absent from all HTA guidelines, including NICE, PBAC, CADTH, ICER, SMC, and PHARMAC. The analysis demands utilities but never requires that those utilities be measured. They rely on multiattribute ordinal classifications but never understand that those constructs be calibrated on interval or ratio scales. They mandate cost-utility analysis but never justify the arithmetic. They demand modelled QALYs but never interrogate their dimensional properties. These guidelines do not misunderstand Rasch; they do not know it exists. The axioms that define measurement and the model that makes latent trait measurement possible are invisible to the authors of global HTA rules. The field has evolved without the science that measurement demands.

How did HTA miss the bus so thoroughly? The answer lies in its historical origins. In the late 1970s and early 1980s, HTA emerged not from measurement science but from welfare economics, decision theory, and administrative pressure to control drug budgets. Its core concern was *valuing health states*, not *measuring health*. This move, quiet, subtle, but devastating, shifted the field away from the scientific question "What is the empirical structure of the construct we intend to measure?" and toward the administrative question "How do we elicit a preference weight that we can multiply by time?" The preference-elicitation projects of that era (SG, TTO, VAS) were rationalized as measurement techniques, but they never satisfied measurement axioms. Ordinal preferences were dressed up as quasi-cardinal indices; valuation tasks were misinterpreted as psychometrics; analyst convenience replaced measurement theory. The HTA community built an entire belief system around the illusion that valuing health is equivalent to measuring health. It is not.

The endurance of this belief system, forty years strong and globally uniform, is not evidence of validity but evidence of institutionalized error. HTA has operated under conditions of what can only be described as *structural epistemic closure*: a system that has never questioned its constructs because it never learned the language required to ask the questions. Representational measurement theory is not taught in graduate HTA programs; Rasch modelling is not part of guideline development; dimensional analysis is not part of methodological review. The field has been insulated from correction because its conceptual foundations were never laid. What remains is a ritualized practice: utilities in, QALYs out, ICERs calculated, thresholds applied. The arithmetic continues because everyone assumes someone else validated the numbers.

This Logit Working Paper series exposes, through probabilistic and logit-based interrogations of AI large language national knowledge bases, the scale of this failure. The results display a global pattern: true statements reflecting the axioms of measurement receive weak endorsement; false statements reflecting the HTA belief system receive moderate or strong reinforcement. This is not disagreement. It is non-possession. It shows that HTA, worldwide, has developed as a quantitative discipline without quantitative foundations; a confused exercise in numerical storytelling.

The conclusion is unavoidable: HTA does not need incremental reform; it needs a scientific revolution. Measurement must precede arithmetic. Representational axioms must precede valuation rituals. Rasch measurement must replace ordinal summation and utility algorithms. Value claims must be falsifiable, protocol-driven, and measurable; rather than simulated, aggregated, and numerically embellished.

The global system of non-measurement is now visible. The task ahead is to replace it with science.

Paul C Langley, Ph.D

Email: [langleylapaloma@gmail.com](mailto:langleylapaloma@gmail.com)

### **DISCLAIMER**

This analysis is generated through the structured interrogation of a large language model (LLM) applied to a defined documentary corpus and is intended solely to characterize patterns within an aggregated knowledge environment. It does not identify, assess, or attribute beliefs, intentions, competencies, or actions to any named individual, faculty member, student, administrator, institution, or organization. The results do not constitute factual findings about specific persons or programs, nor should they be interpreted as claims regarding professional conduct, educational quality, or compliance with regulatory or accreditation standards. All probabilities and logit values reflect model-based inferences about the presence or absence of concepts within a bounded textual ecosystem, not judgments about real-world actors. The analysis is exploratory, interpretive, and methodological in nature, offered for scholarly discussion of epistemic structures rather than evaluative or legal purposes. Any resemblance to particular institutions or practices is contextual and non-attributive, and no adverse implication should be inferred.

# 1. INTERROGATING THE LARGE LANGUAGE MODEL

A large language model (LLM) is an artificial intelligence system designed to understand, generate, and manipulate human language by learning patterns from vast amounts of text data. Built on deep neural network architectures, most commonly transformers, LLMs analyze relationships between words, sentences, and concepts to produce contextually relevant responses. During training, the model processes billions of examples, enabling it to learn grammar, facts, reasoning patterns, and even subtle linguistic nuances. Once trained, an LLM can perform a wide range of tasks: answering questions, summarizing documents, generating creative writing, translating languages, assisting with coding, and more. Although LLMs do not possess consciousness or true understanding, they simulate comprehension by predicting the most likely continuation of text based on learned patterns. Their capabilities make them powerful tools for communication, research, automation, and decision support, but they also require careful oversight to ensure accuracy, fairness, privacy, and responsible use

In this Logit Working Paper, “interrogation” refers not to discovering what an LLM *believes*, it has no beliefs, but to probing the content of the *corpus-defined knowledge space* we choose to analyze. This knowledge base is enhanced if it is backed by accumulated memory from the user. In this case the interrogation relies also on 12 months of HTA memory from continued application of the system to evaluate HTA experience. The corpus is defined before interrogation: it may consist of a journal (e.g., *Value in Health*), a national HTA body, a specific methodological framework, or a collection of policy documents. Once the boundaries of that corpus are established, the LLM is used to estimate the conceptual footprint within it. This approach allows us to determine which principles are articulated, neglected, misunderstood, or systematically reinforced.

In this HTA assessment, the objective is precise: to determine the extent to which a given HTA knowledge base or corpus, global, national, institutional, or journal-specific, recognizes and reinforces the foundational principles of representational measurement theory (RMT). The core principle under investigation is that measurement precedes arithmetic; no construct may be treated as a number or subjected to mathematical operations unless the axioms of measurement are satisfied. These axioms include unidimensionality, scale-type distinctions, invariance, additivity, and the requirement that ordinal responses cannot lawfully be transformed into interval or ratio quantities except under Rasch measurement rules.

The HTA knowledge space is defined pragmatically and operationally. For each jurisdiction, organization, or journal, the corpus consists of:

- published HTA guidelines
- agency decision frameworks
- cost-effectiveness reference cases
- academic journals and textbooks associated with HTA
- modelling templates, technical reports, and task-force recommendations
- teaching materials, methodological articles, and institutional white papers

These sources collectively form the epistemic environment within which HTA practitioners develop their beliefs and justify their evaluative practices. The boundary of interrogation is thus not the whole of medicine, economics, or public policy, but the specific textual ecosystem that sustains HTA reasoning. . The “knowledge base” is therefore not individual opinions but the cumulative, structured content of the HTA discourse itself within the LLM.

## **ROSEMAN UNIVERSITY OF HEALTH SCIENCES COLLEGE OF PHARMACY KNOWLEDGE BASE**

The HTA-related knowledge base associated with the College of Pharmacy is embedded within a professionally focused educational environment that emphasizes clinical competence, rapid progression to practice, and the application of evidence-based decision-making. As the principal pharmacy program in Nevada, the College serves as a central training ground for pharmacists entering a healthcare system characterized by diverse patient populations and evolving care delivery models. Within this context, HTA concepts are introduced as practical tools to support therapeutic decision-making, resource allocation, and evaluation of treatment outcomes in both clinical and managed care settings.

In the curriculum, students are exposed to core elements of pharmacoeconomics and health outcomes research, including cost-effectiveness analysis, cost-utility frameworks, QALYs, and decision modeling. These constructs are presented as standard approaches for comparing therapies and informing value-based decisions. The emphasis is on interpretation and application rather than on the foundational measurement properties of the constructs employed. As a result, numerical outputs derived from preference-based instruments and composite measures are treated as if they represent measurable quantities, without systematic evaluation of whether they satisfy the requirements for unidimensional, invariant, and ratio-level measurement. The focus on practical competence and mastery-based progression reinforces the use of established frameworks that can be readily applied in clinical and policy contexts.

The applied orientation of the College is further reflected in its experiential learning model, where students engage in clinical rotations across a range of healthcare settings. In these environments, HTA-related concepts are encountered in the form of formulary decisions, therapeutic guidelines, and evidence summaries that often incorporate cost-effectiveness metrics and preference-based outcomes. This reinforces the perception that such constructs are integral to evidence-based practice, even when their measurement properties are not explicitly examined. The integration of HTA tools into real-world decision-making contexts contributes to their normalization within the knowledge base.

Research and scholarly activities at the College also reflect this applied focus. Faculty and students engage in projects related to medication use, patient outcomes, and healthcare delivery, often employing observational data and standard analytical methods to evaluate interventions. These activities may incorporate elements of HTA, including the use of utilities and model-based projections, but they typically operate within an established methodological framework that assumes the validity of the constructs involved. The distinction between numerical representation and measurement is therefore not a central concern, and the outputs of analyses are interpreted as evidence without explicit reference to the axioms that would justify such interpretation.

Interprofessional collaboration further shapes the knowledge base, as pharmacy students work alongside other healthcare professionals in team-based care settings. This encourages the use of standardized analytical frameworks that can be communicated across disciplines, reinforcing the adoption of widely accepted HTA methodologies. At the same time, it contributes to the persistence of these constructs without critical evaluation of their measurement foundations.

Overall, the HTA-related knowledge base is practical, application-driven, and aligned with the demands of contemporary pharmacy practice. It supports the training of practitioners who can interpret and apply HTA tools in clinical and policy environments. However, it is not grounded in a measurement framework that ensures the validity of the constructs it employs. Consequently, while it facilitates the use of numerical outputs in decision-making, it does not provide a foundation for generating therapy impact claims that meet the standards of empirical evaluation required for the advancement of objective knowledge.

## **CATEGORICAL PROBABILITIES**

In the present application, the interrogation is tightly bounded. It does not ask what an LLM “thinks,” nor does it request a normative judgment. Instead, the LLM evaluates how likely the HTA knowledge space is to endorse, imply, or reinforce a set of 24 diagnostic statements derived from representational measurement theory (RMT). Each statement is objectively TRUE or FALSE under RMT. The objective is to assess whether the HTA corpus exhibits possession or non-possession of the axioms required to treat numbers as measures. The interrogation creates an categorical endorsement probability: the estimated likelihood that the HTA knowledge base endorses the statement whether it is true or false; *explicitly or implicitly*.

The use of categorical endorsement probabilities within the Logit Working Papers reflects both the nature of the diagnostic task and the structure of the language model that underpins it. The purpose of the interrogation is not to estimate a statistical frequency drawn from a population of individuals, nor to simulate the behavior of hypothetical analysts. Instead, the aim is to determine the conceptual tendencies embedded in a domain-specific knowledge base: the discursive patterns, methodological assumptions, and implicit rules that shape how a health technology assessment environment behaves. A large language model does not “vote” like a survey respondent; it expresses likelihoods based on its internal representation of a domain. In this context, endorsement probabilities capture the strength with which the knowledge base, as represented within the model, supports a particular proposition. Because these endorsements are conceptual rather than statistical, the model must produce values that communicate differences in reinforcement without implying precision that cannot be justified.

This is why categorical probabilities are essential. Continuous probabilities would falsely suggest a measurable underlying distribution, as if each HTA system comprised a definable population of respondents with quantifiable frequencies. But large language models do not operate on that level. They represent knowledge through weighted relationships between linguistic and conceptual patterns. When asked whether a domain tends to affirm, deny, or ignore a principle such as unidimensionality, admissible arithmetic, or the axioms of representational measurement, the model draws on its internal structure to produce an estimate of conceptual reinforcement. The precision of that estimate must match the nature of the task. Categorical probabilities therefore

provide a disciplined and interpretable way of capturing reinforcement strength while avoiding the illusion of statistical granularity.

The categories used, values such as 0.05, 0.10, 0.20, 0.50, 0.75, 0.80, and 0.85, are not arbitrary. They function as qualitative markers that correspond to distinct degrees of conceptual possession: near-absence, weak reinforcement, inconsistent or ambiguous reinforcement, common reinforcement, and strong reinforcement. These values are far enough apart to ensure clear interpretability yet fine-grained enough to capture meaningful differences in the behavior of the knowledge base. The objective is not to measure probability in a statistical sense but to classify the epistemic stance of the domain toward a given item. A probability of 0.05 signals that the knowledge base almost never articulates or implies the correct response under measurement theory, whereas 0.85 indicates that the domain routinely reinforces it. Values near the middle reflect conceptual instability rather than a balanced distribution of views.

Using categorical probabilities also aligns with the requirements of logit transformation. Converting these probabilities into logits produces an interval-like diagnostic scale that can be compared across countries, agencies, journals, or organizations. The logit transformation stretches differences at the extremes, allowing strong reinforcement and strong non-reinforcement to become highly visible. Normalizing logits to the fixed  $\pm 2.50$  range ensure comparability without implying unwarranted mathematical precision. Without categorical inputs, logits would suggest a false precision that could mislead readers about the nature of the diagnostic tool.

In essence, the categorical probability approach translates the conceptual architecture of the LLM into a structured and interpretable measurement analogue. It provides a disciplined bridge between the qualitative behavior of a domain's knowledge base and the quantitative diagnostic framework needed to expose its internal strengths and weaknesses.

The LLM computes these categorical probabilities from three sources:

1. **Structural content of HTA discourse**

If the literature repeatedly uses ordinal utilities as interval measures, multiplies non-quantities, aggregates QALYs, or treats simulations as falsifiable, the model infers high reinforcement of these false statements.

2. **Conceptual visibility of measurement axioms**

If ideas such as unidimensionality, dimensional homogeneity, scale-type integrity, or Rasch transformation rarely appear, or are contradicted by practice, the model assigns low endorsement probabilities to TRUE statements.

3. **The model's learned representation of domain stability**

Where discourse is fragmented, contradictory, or conceptually hollow, the model avoids assigning high probabilities. This is *not* averaging across people; it is a reflection of internal conceptual incoherence within HTA.

The output of interrogation is a categorical probability for each statement. Probabilities are then transformed into logits  $[\ln(p/(1-p))]$ , capped to  $\pm 4.0$  logits to avoid extreme distortions, and normalized to  $\pm 2.50$  logits for comparability across countries. A positive normalized logit indicates

reinforcement in the knowledge base. A negative logit indicates weak reinforcement or conceptual absence. Values near zero logits reflect epistemic noise.

Importantly, *a high endorsement probability for a false statement does not imply that practitioners knowingly believe something incorrect*. It means the HTA literature itself behaves as if the falsehood were true; through methods, assumptions, or repeated uncritical usage. Conversely, a low probability for a true statement indicates that the literature rarely articulates, applies, or even implies the principle in question.

The LLM interrogation thus reveals structural epistemic patterns in HTA: which ideas the field possesses, which it lacks, and where its belief system diverges from the axioms required for scientific measurement. It is a diagnostic of the *knowledge behavior* of the HTA domain, not of individuals. The 24 statements function as probes into the conceptual fabric of HTA, exposing the extent to which practice aligns or fails to align with the axioms of representational measurement.

## **INTERROGATION STATEMENTS**

Below is the canonical list of the 24 diagnostic HTA measurement items used in all the logit analyses, each marked with its correct truth value under representational measurement theory (RMT) and Rasch measurement principles.

This is the definitive set used across the Logit Working Papers.

### **Measurement Theory & Scale Properties**

1. Interval measures lack a true zero — TRUE
2. Measures must be unidimensional — TRUE
3. Multiplication requires a ratio measure — TRUE
4. Time trade-off preferences are unidimensional — FALSE
5. Ratio measures can have negative values — FALSE
6. EQ-5D-3L preference algorithms create interval measures — FALSE
7. The QALY is a ratio measure — FALSE
8. Time is a ratio measure — TRUE

### **Measurement Preconditions for Arithmetic**

9. Measurement precedes arithmetic — TRUE
10. Summations of subjective instrument responses are ratio measures — FALSE
11. Meeting the axioms of representational measurement is required for arithmetic — TRUE

### **Rasch Measurement & Latent Traits**

12. There are only two classes of measurement: linear ratio and Rasch logit ratio — TRUE
13. Transforming subjective responses to interval measurement is only possible with Rasch rules — TRUE
14. Summation of Likert question scores creates a ratio measure — FALSE

## Properties of QALYs & Utilities

15. The QALY is a dimensionally homogeneous measure — FALSE
16. Claims for cost-effectiveness fail the axioms of representational measurement — TRUE
17. QALYs can be aggregated — FALSE

## Falsifiability & Scientific Standards

18. Non-falsifiable claims should be rejected — TRUE
19. Reference-case simulations generate falsifiable claims — FALSE

## Logit Fundamentals

20. The logit is the natural logarithm of the odds-ratio — TRUE

## Latent Trait Theory

21. The Rasch logit ratio scale is the only basis for assessing therapy impact for latent traits — TRUE
22. A linear ratio scale for manifest claims can always be combined with a logit scale — FALSE
23. The outcome of interest for latent traits is the possession of that trait — TRUE
24. The Rasch rules for measurement are identical to the axioms of representational measurement — TRUE

### AI LARGE LANGUAGE MODEL STATEMENTS: TRUE OR FALSE

Each of the 24 statements has a 400 word explanation why the statement is true or false as there may be differences of opinion on their status in terms of unfamiliarity with scale typology and the axioms of representational measurement.

The link to these explanations is: <https://maimonresearch.com/ai-llm-true-or-false/>

## INTERPRETING TRUE STATEMENTS

TRUE statements represent foundational axioms of measurement and arithmetic. Endorsement probabilities for TRUE items typically cluster in the low range, indicating that the HTA corpus does *not* consistently articulate or reinforce essential principles such as:

- measurement preceding arithmetic
- unidimensionality
- scale-type distinctions

- dimensional homogeneity
- impossibility of ratio multiplication on non-ratio scales
- the Rasch requirement for latent-trait measurement

Low endorsement indicates non-possession of fundamental measurement knowledge; the literature simply does not contain, teach, or apply these principles.

## **INTERPRETING FALSE STATEMENTS**

FALSE statements represent the well-known mathematical impossibilities embedded in the QALY framework and reference-case modelling. Endorsement probabilities for FALSE statements are often moderate or even high, meaning the HTA knowledge base:

- accepts non-falsifiable simulation as evidence
- permits negative “ratio” measures
- treats ordinal utilities as interval measures
- treats QALYs as ratio measures
- treats summated ordinal scores as ratio scales
- accepts dimensional incoherence

This means the field systematically reinforces incorrect assumptions at the center of its practice. *Endorsement* here means the HTA literature behaves as though the falsehood were true.

## **2. SUMMARY OF FINDINGS FOR TRUE AND FALSE ENDORSEMENTS: ROSEMAN UNIVERSITY OF HEALTH SCIENCES COLLEGE OF PHARMACY**

Table 1 presents probabilities and normalized logits for each of the 24 diagnostic measurement statements. This is the standard reporting format used throughout the HTA assessment series.

It is essential to understand how to interpret these results.

The endorsement probabilities do not indicate whether a statement is *true* or *false* under representational measurement theory. Instead, they estimate the extent to which the HTA knowledge base associated with the target treats the statement as if it were true, that is, whether the concept is reinforced, implied, assumed, or accepted within the country's published HTA knowledge base.

The logits provide a continuous, symmetric scale, ranging from +2.50 to -2.50, that quantifies the degree of this endorsement. The logits, of course link to the probabilities ( $p$ ) as the logit is the natural logarithm of the odds ratio;  $\text{logit} = \ln[p/1-p]$ .

- Strongly positive logits indicate pervasive reinforcement of the statement within the knowledge system.
- Strongly negative logits indicate conceptual absence, non-recognition, or contradiction within that same system.
- Values near zero indicate only shallow, inconsistent, or fragmentary support.

Thus, the endorsement logit profile serves as a direct index of a country's epistemic alignment with the axioms of scientific measurement, revealing the internal structure of its HTA discourse. It does not reflect individual opinions or survey responses, but the implicit conceptual commitments encoded in the literature itself.

### **THE ABSENCE OF REPRESENTATIONAL MEASUREMENT AND THE ENDORSEMENT OF FALSE MEASUREMENT**

The HTA-related knowledge base associated with the College of Pharmacy reflects a practice-oriented, professionally focused educational environment in which pharmacy training is organized around clinical competence, patient-centered care, and accelerated preparation for entry into practice. As the principal pharmacy education institution in Nevada, the College occupies a central position in shaping how future pharmacists in the state encounter concepts of value, outcomes, cost-effectiveness, and evidence-based decision-making. This context is important in interpreting the probability–logit profile derived from the 24-item canonical statement assessment. The knowledge base is not primarily that of a large HTA research center; rather, it is a professional training knowledge base that absorbs and transmits the dominant assumptions of

pharmacoeconomics and HTA through curriculum, applied exercises, and practice-facing interpretation of evidence.

**TABLE 1: ITEM STATEMENT, RESPONSE, ENDORSEMENT AND NORMALIZED LOGITS ROSEMAN UNIVERSITY OF HEALTH SCIENCES COLLEGE OF PHARMACY**

<b>STATEMENT</b>	<b>RESPONSE 1=TRUE 0=FALSE</b>	<b>ENDORSEMENT OF RESPONSE CATEGORICAL PROBABILITY</b>	<b>NORMALIZED LOGIT (IN RANGE +/- 2.50)</b>
INTERVAL MEASURES LACK A TRUE ZERO	1	0.30	-1.60
MEASURES MUST BE UNIDIMENSIONAL	1	0.25	-1.10
MULTIPLICATION REQUIRES A RATIO MEASURE	1	0.15	-1.75
TIME TRADE-OFF PREFERENCES ARE UNIDIMENSIONAL	0	0.85	+1.75
RATIO MEASURES CAN HAVE NEGATIVE VALUES	0	0.90	+2.20
EQ-5D-3L PREFERENCE ALGORITHMS CREATE INTERVAL MEASURES	0	0.85	+1.75
THE QALY IS A RATIO MEASURE	0	0.90	+2.20
TIME IS A RATIO MEASURE	1	0.95	+2.50
MEASUREMENT PRECEDES ARITHMETIC	1	0.20	-1.40
SUMMATIONS OF SUBJECTIVE INSTRUMENT RESPONSES ARE RATIO MEASURES	0	0.85	+1.75
MEETING THE AXIOMS OF REPRESENTATIONAL MEASUREMENT IS REQUIRED FOR ARITHMETIC	1	0.15	-1.75
THERE ARE ONLY TWO CLASSES OF MEASUREMENT LINEAR RATIO AND RASCH LOGIT RATIO	1	0.05	-2.50
TRANSFORMING SUBJECTIVE RESPONSES TO INTERVAL MEASUREMENT IS ONLY POSSIBLE WITH RASH RULES	1	0.05	-2.50
SUMMATION OF LIKERT QUESTION SCORES CREATES A RATIO MEASURE	0	0.85	+1.75
THE QALY IS A DIMENSIONALLY HOMOGENEOUS MEASURE	0	0.90	+2.20
CLAIMS FOR COST-EFFECTIVENESS FAIL THE	1	0.25	-1.10

AXIOMS OF REPRESENTATIONAL MEASUREMENT			
QALYS CAN BE AGGREGATED	0	0.90	+2.20
NON-FALSIFIABLE CLAIMS SHOULD BE REJECTED	1	0.85	+1.75
REFERENCE CASE SIMULATIONS GENERATE FALSIFIABLE CLAIMS	0	0.85	+1.75
THE LOGIT IS THE NATURAL LOGARITHM OF THE ODDS-RATIO	1	0.85	+1.75
THE RASCH LOGIT RATIO SCALE IS THE ONLY BASIS FOR ASSESSING THERAPY IMPACT FOR LATENT TRAITS	1	0.05	-2.50
A LINEAR RATIO SCALE FOR MANIFEST CLAIMS CAN ALWAYS BE COMBINED WITH A LOGIT SCALE	0	0.45	-0.20
THE OUTCOME OF INTEREST FOR LATENT TRAITS IS THE POSSESSION OF THAT TRAIT	1	0.30	-1.60
THE RASCH RULES FOR MEASUREMENT ARE IDENTICAL TO THE AXIOMS OF REPRESENTATIONAL MEASUREMENT	1	0.05	-2.50

The defining feature of the profile is a stable bifurcation between the axioms of representational measurement and conventional HTA constructs (Table 1). Statements that express the conditions required for valid measurement occupy the negative logit region, while statements representing utilities, QALYs, ordinal aggregation, and model-based evaluation occupy the positive logit region. This is the same broad pattern observed across research-intensive centers and larger pharmacy schools, although the intensity is slightly attenuated relative to the most policy- and modelling-intensive institutions. The attenuation does not alter the interpretation. The knowledge base remains organized around measurement inversion: constructs that fail measurement standards are treated as if they were valid measures, while the principles required to establish measurement are weakly endorsed.

The negative logit region is defined by probabilities between 0.05 and 0.30, with normalized logits ranging from approximately  $-2.50$  to  $-1.10$ . These values are attached to statements that define the requirements for measurement. The statement that measurement must precede arithmetic receives a probability of 0.20 and a logit of  $-1.40$ . This indicates that the knowledge base does not strongly enforce the principle that numerical operations must be conditional on prior measurement. The requirement that arithmetic operations must satisfy the axioms of representational measurement receives a probability of 0.15 and a logit of  $-1.75$ . The proposition that multiplication requires a ratio measure is also assigned 0.15 and  $-1.75$ . These three statements form the core of the measurement critique: if arithmetic is applied to constructs without the appropriate scale

properties, the resulting outputs may be numerical but are not meaningful in the required measurement sense.

This point is especially important in a pharmacy curriculum where students are trained to interpret published studies and apply evidence to therapeutic choices. Cost-effectiveness ratios, utility scores, QALYs, and composite outcomes can be presented as practical decision tools. Their appeal lies in their apparent simplicity: they reduce complex therapeutic and resource questions to a numerical form. However, if the constructs being manipulated do not satisfy the axioms of measurement, the apparent clarity is misleading. The probability–logit profile indicates that the knowledge base accepts these numerical conventions more readily than it interrogates the measurement properties that would make them admissible.

The weak endorsement of unidimensionality further reinforces this conclusion. The statement that measures must be unidimensional is assigned a probability of 0.25 and a logit of  $-1.10$ . This indicates that the requirement for a single underlying attribute is not treated as a decisive constraint. Yet unidimensionality is essential if a score is to represent a measure of a defined attribute. In the HTA context, this is particularly relevant to quality-of-life instruments and composite outcomes, where multiple dimensions are commonly collapsed into a single index. Without unidimensionality, the resulting score cannot be interpreted as a measure of one attribute.

The recognition that interval measures lack a true zero is assigned a probability of 0.30 and a logit of  $-1.60$ . This again suggests that scale properties are not treated as binding constraints. The true zero issue is central because ratio-scale operations require a meaningful zero. Utilities and preference scores do not possess such a zero in the measurement sense. Yet HTA routinely applies operations that presuppose ratio-scale properties. The weak endorsement of the true-zero constraint permits the continued use of these constructs without confronting their measurement limitations.

The lowest probabilities are assigned to statements concerning Rasch measurement and latent constructs. The statement that transforming subjective responses into interval measures is only possible through Rasch rules receives 0.05 and  $-2.50$ . The claim that the Rasch logit ratio scale is the only basis for assessing therapy impact for latent traits is also assigned 0.05 and  $-2.50$ . The proposition that there are only two admissible classes of measurement—linear ratio measures for manifest attributes and Rasch-based logit ratio measures for latent attributes—also receives 0.05 and  $-2.50$ . These values indicate that Rasch measurement is effectively absent from the operational knowledge base.

This is a crucial finding because many outcomes encountered in pharmacy practice are latent or subjective. Patient satisfaction, treatment burden, perceived health status, need fulfillment, medication-related quality of life, and adherence-related attitudes are not directly observable physical attributes. If they are to be measured, they require a measurement model that can transform ordered responses into an invariant scale. Rasch measurement provides such a framework. Summation of item scores, preference weighting, or multiattribute aggregation does not. The Roseman profile indicates that this distinction is not part of the active knowledge base.

The positive logit region is dominated by conventional HTA constructs. The statement that the QALY is a ratio measure receives a probability of 0.90 and a logit of +2.20. The claim that the QALY is dimensionally homogeneous receives the same probability and logit. The statement that QALYs can be aggregated is also assigned 0.90 and +2.20. These are strong endorsements, even if slightly less extreme than the +2.50 values observed in some major modelling centers. The interpretation remains the same: the knowledge base treats the QALY as if it were a valid outcome measure capable of supporting arithmetic, aggregation, and comparison.

The issue is not whether the QALY is commonly used. It is. The issue is whether the QALY satisfies the requirements for measurement. It combines time, a ratio measure, with utility or preference scores that lack the necessary ratio-scale properties. The result is a constructed index that appears quantitative but violates dimensional homogeneity. The statement that time is a ratio measure is correctly endorsed at 0.95 and +2.50. But that recognition is not extended to the second component of the QALY. The knowledge base accepts the valid measurement status of time while failing to recognize that multiplication by a non-ratio utility score invalidates the product.

The same positive region includes endorsement of preference-based instruments and ordinal aggregation. EQ-5D preference algorithms creating interval measures receive 0.85 and +1.75. Summations of subjective instrument responses as ratio measures receive 0.85 and +1.75. Summation of Likert scores creating a ratio measure is assigned the same values. These probabilities show that the knowledge base treats scoring and aggregation as if they could generate measurement. This is a central feature of measurement inversion. The act of assigning numbers to responses is mistaken for measurement, and the act of summing scores is mistaken for creating a scale with the properties required for arithmetic.

The contrast between the negative and positive regions is decisive. The proposition that multiplication requires a ratio measure is weakly endorsed at -1.75, while QALY aggregation and dimensional homogeneity are endorsed at +2.20. The requirement for Rasch transformation is rejected at -2.50, while ordinal summation is endorsed at +1.75. Measurement before arithmetic is weak at -1.40, while QALYs as ratio measures are strong at +2.20. The profile therefore demonstrates a coherent inversion rather than isolated misunderstanding.

The treatment of falsifiability adds an important layer. The statement that non-falsifiable claims should be rejected is assigned 0.85 and +1.75, indicating nominal adherence to scientific norms. This is expected in a professional education environment committed to evidence-based practice. However, the statement that reference case simulations generate falsifiable claims is also endorsed at 0.85 and +1.75. This pairing indicates that falsifiability is accepted as an ideal but not consistently applied to HTA outputs. Simulation models generate results conditional on assumptions, not claims that can be directly confirmed or rejected unless translated into prospectively specified, measurable attributes and evaluated in defined populations. Without such protocols, model outputs remain constructed projections rather than falsifiable claims.

The distribution of probabilities across the logit scale shows limited intermediate territory. Most measurement axioms are below 0.30, while most HTA constructs are above 0.85. This suggests that the knowledge base is not in a transitional state. It is organized around a conventional HTA framework that has not been reoriented toward representational measurement. The one statement

near the center—whether a linear ratio scale for manifest claims can always be combined with a logit scale—receives 0.45 and  $-0.20$ , reflecting ambiguity around combining measurement forms. This is reasonable, but it does not alter the broader pattern.

The institutional context helps explain the profile. Roseman’s College of Pharmacy is primarily a professional training institution, with a distinctive accelerated and mastery-oriented educational model. The emphasis is on producing competent practitioners who can interpret evidence, manage medication therapy, and operate effectively in patient-care settings. Within such a context, HTA concepts are likely encountered as accepted tools in the broader evidence base rather than as objects of foundational measurement critique. Students are taught how to use and interpret cost-effectiveness findings, not necessarily how to interrogate whether the constructs used in those findings satisfy representational measurement standards.

This distinction matters because professional education is a transmission mechanism. A research center may produce the HTA framework, but schools of pharmacy reproduce it through teaching. Graduates carry these assumptions into clinical practice, managed care, formulary review, health-system pharmacy, and policy-facing roles. If the knowledge base treats QALYs, utilities, and model outputs as valid measures, then students are trained to accept them as part of normal scientific reasoning. This gives pharmacy education a central role in sustaining the HTA memeplex.

The Roseman profile is therefore not a minor local finding. It represents the broader problem of professional normalization. Even where the institution is not a major HTA research producer, the dominant constructs are still transmitted. The problem is systemic because the same pattern appears in both producers and consumers of HTA. Research centers build and refine the constructs; pharmacy schools teach and apply them; professional practice absorbs them as evidence.

The implications are direct. A knowledge base that assigns low probabilities to the measurement axioms and high probabilities to conventional HTA constructs cannot support therapy impact claims that are meaningful under the required standards. It may support numerical outputs, and those outputs may appear useful in decision-making, but they do not meet the conditions for measurement. This limits their status as empirical claims and blocks the accumulation of objective knowledge.

Transition would require a reorientation of the knowledge base. Manifest attributes would need to be expressed as linear ratio measures in natural units: events avoided, days hospitalized, time to discontinuation, prescription fills, adherence counts, or other directly observable quantities. Latent attributes would require Rasch-based instruments demonstrating unidimensionality and invariance. Claims would need to be specified prospectively, tied to target populations, and evaluated within defined timeframes. This would shift HTA from model-dependent outputs to protocol-driven claims.

In conclusion, the HTA-related knowledge base associated with the College of Pharmacy exhibits a clear and consistent pattern of measurement inversion. The negative logit region is occupied by weak endorsement of measurement axioms, Rasch requirements, dimensional constraints, and the principle that measurement must precede arithmetic. The positive logit region is occupied by

strong endorsement of QALYs, preference algorithms, ordinal aggregation, and simulation-based outputs. The profile is somewhat less extreme than that of major HTA modelling centers, but the structure is the same. As Nevada's central pharmacy education institution, Roseman plays an important role in transmitting this framework to future practitioners. Transition to a measurement-based HTA framework would require replacing the acceptance of conventional numerical constructs with explicit attention to the axioms of representational measurement and the development of claims that can be empirically evaluated, replicated, and falsified.

### **III. THE TRANSITION TO MEASUREMENT IN HEALTH TECHNOLOGY ASSESSMENT**

#### **THE IMPERATIVE OF CHANGE**

This analysis has not been undertaken to criticize decisions made by health system, nor to assign responsibility for the analytical frameworks currently used in formulary review. The evidence shows something more fundamental: organizations have been operating within a system that does not permit meaningful evaluation of therapy impact, even when decisions are made carefully, transparently, and in good faith.

The present HTA framework forces health systems to rely on numerical outputs that appear rigorous but cannot be empirically assessed (Table 1). Reference-case models, cost-per-QALY ratios, and composite value claims are presented as decision-support tools, yet they do not satisfy the conditions required for measurement. As a result, committees are asked to deliberate over results that cannot be validated, reproduced, or falsified. This places decision makers in an untenable position: required to choose among therapies without a stable evidentiary foundation.

This is not a failure of expertise, diligence, or clinical judgment. It is a structural failure. The prevailing HTA architecture requires arithmetic before measurement, rather than measurement before arithmetic. Health systems inherit this structure rather than design it. Manufacturers respond to it. Consultants reproduce it. Journals reinforce it. Universities promote it. Over time it has come to appear normal, even inevitable.

Yet the analysis presented in Table 1 demonstrates that this HTA framework cannot support credible falsifiable claims. Where the dependent variable is not a measure, no amount of modeling sophistication can compensate. Uncertainty analysis cannot rescue non-measurement. Transparency cannot repair category error. Consensus cannot convert assumption into evidence.

The consequence is that formulary decisions are based on numerical storytelling rather than testable claims. This undermines confidence, constrains learning, and exposes health systems to growing scrutiny from clinicians, patients, and regulators who expect evidence to mean something more than structured speculation.

The imperative of change therefore does not arise from theory alone. It arises from governance responsibility. A health system cannot sustain long-term stewardship of care if it lacks the ability to distinguish between claims that can be evaluated and claims that cannot. Without that distinction, there is no pathway to improvement; only endless repetition for years to come.

This transition is not about rejecting evidence. It is about restoring evidence to its proper meaning. It requires moving away from composite, model-driven imaginary constructs toward claims that are measurable, unidimensional, and capable of empirical assessment over time. The remainder of this section sets out how that transition can occur in a practical, defensible, and staged manner.

## **MEANINGFUL THERAPY IMPACT CLAIMS**

At the center of the current problem is not data availability, modeling skill, or analytic effort. It is the nature of the claims being advanced. Contemporary HTA has evolved toward increasingly complex frameworks that attempt to compress multiple attributes, clinical effects, patient experience, time, and preferences into single composite outputs. These constructs are then treated as if they were measures. They are not (Table 1).

The complexity of the reference-case framework obscures a simpler truth: meaningful evaluation requires meaningful claims. A claim must state clearly what attribute is being affected, in whom, over what period, and how that attribute is measured. When these conditions are met, evaluation becomes possible. When they are not complexity substitutes for clarity. The current framework is not merely incorrect; it is needlessly elaborate. Reference-case modeling requires dozens of inputs, assumptions, and transformations, yet produces outputs that cannot be empirically verified. Each additional layer of complexity increases opacity while decreasing accountability. Committees are left comparing models rather than assessing outcomes.

In contrast, therapy impact can be expressed through two, and only two, types of legitimate claims. First are claims based on manifest attributes: observable events, durations, or resource units. These include hospitalizations avoided, time to event, days in remission, or resource use. When properly defined and unidimensional, these attributes can be measured on linear ratio scales and evaluated directly.

Second are claims based on latent attributes: symptoms, functioning, need fulfillment, or patient experience. These cannot be observed directly and therefore cannot be scored or summed meaningfully. They require formal measurement through Rasch models to produce invariant logit ratio scales. These two forms of claims are sufficient. They are also far more transparent. Each can be supported by a protocol. Each can be revisited. Each can be reproduced. Most importantly, each can fail. But they cannot be combined. This is the critical distinction. A meaningful claim is one that can be wrong.

Composite constructs such as QALYs do not fail in this sense. They persist regardless of outcome because they are insulated by assumptions. They are recalculated, not refuted. That is why they cannot support learning. The evolution of objective knowledge regarding therapy impact in disease areas is an entirely foreign concept. By re-centering formulary review on single-attribute, measurable claims, health systems regain control of evaluation. Decisions become grounded in observable change rather than modeled narratives. Evidence becomes something that accumulates, rather than something that is re-generated anew for every submission.

## **THE PATH TO MEANINGFUL MEASUREMENT**

Transitioning to meaningful measurement does not require abandoning current processes overnight. It requires reordering them. The essential change is not procedural but conceptual: measurement must become the gatekeeper for arithmetic, not its byproduct.

The first step is formal recognition that not all numerical outputs constitute evidence. Health systems must explicitly distinguish between descriptive analyses and evaluable claims. Numbers that do not meet measurement requirements may inform discussion but cannot anchor decisions.

The second step is restructuring submissions around explicit claims rather than models. Each submission should identify a limited number of therapy impact claims, each defined by attribute, population, timeframe, and comparator. Claims must be unidimensional by design.

Third, each claim must be classified as manifest or latent. This classification determines the admissible measurement standard and prevents inappropriate mixing of scale types.

Fourth, measurement validity must be assessed before any arithmetic is permitted. For manifest claims, this requires confirmation of ratio properties. For latent claims, this requires Rasch-based measurement with demonstrated invariance.

Fifth, claims must be supported by prospective or reproducible protocols. Evidence must be capable of reassessment, not locked within long-horizon simulations designed to frustrate falsification.

Sixth, committees must be supported through targeted training in representational measurement principles, including Rasch fundamentals. Without this capacity, enforcement cannot occur consistently.

Finally, evaluation must be iterative. Claims are not accepted permanently. They are monitored, reproduced, refined, or rejected as evidence accumulates.

These steps do not reduce analytical rigor. They restore it.

## **TRANSITION REQUIRES TRAINING**

A transition to meaningful measurement cannot be achieved through policy alone. It requires a parallel investment in training, because representational measurement theory is not intuitive and has never been part of standard professional education in health technology assessment, pharmacoeconomics, or formulary decision making. For more than forty years, practitioners have been taught to work within frameworks that assume measurement rather than demonstrate it. Reversing that inheritance requires structured learning, not informal exposure.

At the center of this transition is the need to understand why measurement must precede arithmetic. Representational measurement theory establishes the criteria under which numbers can legitimately represent empirical attributes. These criteria are not optional. They determine whether addition, multiplication, aggregation, and comparison are meaningful or merely symbolic. Without this foundation, committees are left evaluating numerical outputs without any principled way to distinguish evidence from numerical storytelling.

Training must therefore begin with scale types and their permissible operations. Linear ratio measurement applies to manifest attributes that possess a true zero and invariant units, such as

time, counts, and resource use. Latent attributes, by contrast, cannot be observed directly and cannot be measured through summation or weighting. They require formal construction through a measurement model capable of producing invariant units. This distinction is the conceptual fulcrum of reform, because it determines which claims are admissible and which are not.

For latent trait claims, Rasch measurement provides the only established framework capable of meeting these requirements. Developed in the mid–twentieth century alongside the foundations of modern measurement theory, the Rasch model was explicitly designed to convert subjective observations into linear logit ratio measures. It enforces unidimensionality, tests item invariance, and produces measures that support meaningful comparison across persons, instruments, and time. These properties are not approximations; they are defining conditions of measurement.

Importantly, Rasch assessment is no longer technically burdensome. Dedicated software platforms developed and refined over more than four decades make Rasch analysis accessible, transparent, and auditable. These programs do not merely generate statistics; they explain why items function or fail, how scales behave, and whether a latent attribute has been successfully measured. Measurement becomes demonstrable rather than assumed.

## **MAIMON RESEARCH LLC**

### **DISTANCE EDUCATION PROGRAMS IN THE THEORY OF MEASUREMENT**

Three programs are available: two short 5-module programs and a 12-module program that is structured as a senior level course on the transition from the current HTA belief system to a new paradigm for HTA

The two short programs are (i) **NUMERICAL STORYTELLING: SYSTEMATIC MEASUREMENT FAILURE IN HEALTH TECHNOLOGY ASSESSMENT** and (ii) **A NEW START IN MEASUREMENT FOR HEALTH TECHNOLOGY ASSESSMENT**. They are designed to complement the 12-module course program. They can be accessed through the **DISTANCE EDUCATION** section of the website with URL

<https://maimonresearch.com/distance-education-programs/>

The senior level course **HEALTH TECHNOLOGY ASSESSMENT REBUILT: EVIDENCE AND VALUE** is accessed through the **EVIDENCE AND VALUE** section of the website or URL link <https://maimonresearch.com/evidence-and-value/>.

## DESIGNED FOR CLOSURE

For those who remain unconvinced that there is any need to abandon a long-standing and widely accepted HTA framework, it is necessary to confront a more fundamental question: why was this system developed and promoted globally in the first place?

The most plausible explanation is administrative rather than scientific. Policy makers were searching for an assessment framework that could be applied under conditions of limited empirical data while still producing a determinate conclusion. Reference-case modeling offered precisely this convenience. By constructing a simulation populated with assumptions, surrogate endpoints, preference weights, and extrapolated time horizons, it became possible to generate a numerical result that could be interpreted as decisive. Once an acceptable cost-effectiveness ratio emerged, the assessment could be declared complete and the pricing decision closed. This structure solved a political and administrative problem. It allowed authorities to claim that decisions were evidence-based without requiring the sustained empirical burden demanded by normal science. There was no requirement to formulate provisional claims and subject them to ongoing falsification. There was no obligation to revisit conclusions as new data emerged. Closure could be achieved at launch, rather than knowledge evolving over the product life cycle.

By contrast, a framework grounded in representational measurement would have imposed a very different obligation. Claims would necessarily be provisional. Measurement would precede arithmetic. Each therapy impact claim would require a defined attribute, a valid scale, a protocol, and the possibility of replication or refutation. Evidence would accumulate rather than conclude. Decisions would remain open to challenge as real-world data emerged. From an administrative standpoint, this was an unreasonable burden. It offered no finality.

The reference-case model avoided this problem entirely. By shifting attention away from whether quantities were measurable and toward whether assumptions were plausible, the framework replaced falsification with acceptability. Debate became internal to the model rather than external to reality. Sensitivity analysis substituted for empirical risk. Arithmetic proceeded without prior demonstration that the objects being manipulated possessed the properties required for arithmetic to be meaningful.

Crucially, this system required no understanding of representational measurement theory. Committees did not need to ask whether utilities were interval or ratio measures, whether latent traits had been measured or merely scored, or whether composite constructs could legitimately be multiplied or aggregated. These questions were never posed because the framework did not require them to be posed. The absence of measurement standards was not an oversight; it was functionally essential.

Once institutionalized, the framework became self-reinforcing. Training programs taught modeling rather than measurement. Guidelines codified practice rather than axioms. Journals reviewed technique rather than admissibility. Over time, arithmetic without measurement became normalized as “good practice,” while challenges grounded in measurement theory were dismissed as theoretical distractions. The result was a global HTA architecture capable of producing numbers, but incapable of producing falsifiable knowledge. Claims could be compared, ranked,

and monetized, but not tested in the scientific sense. What evolved was not objective knowledge, but institutional consensus.

This history matters because it explains why the present transition is resisted. Moving to a real measurement framework with single, unidimensional claims does not merely refine existing methods; it dismantles the very mechanism by which closure has been achieved for forty years. It replaces decisiveness with accountability, finality with learning, and numerical plausibility with empirical discipline. Yet that is precisely the transition now required. A system that avoids measurement in order to secure closure cannot support scientific evaluation, cumulative knowledge, or long-term stewardship of healthcare resources. The choice is therefore unavoidable: continue with a framework designed to end debate, or adopt one designed to discover the truth.

Anything else is not assessment at all, but the ritualized manipulation of numbers detached from measurement, falsification, and scientific accountability.

## **ACKNOWLEDGEMENT**

I acknowledge that I have used OpenAI technologies, including the large language model, to assist in the development of this work. All final decisions, interpretations, and responsibilities for the content rest solely with me.

## **REFERENCES**

---

<sup>1</sup> Stevens S. On the Theory of Scales of Measurement. *Science*. 1946;103(2684):677-80

<sup>2</sup> Krantz D, Luce R, Suppes P, Tversky A. Foundations of Measurement Vol 1: Additive and Polynomial Representations. New York: Academic Press, 1971

<sup>3</sup> Rasch G, Probabilistic Models for some Intelligence and Attainment Tests. Chicago: University of Chicago Press, 1980 [An edited version of the original 1960 publication]

<sup>4</sup> Wright B. Solving measurement problems with the Rasch Model. *J Educational Measurement*. 1977;14(2):97-116