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REPRESENTATIONAL MEASUREMENT FAILURE IN HEALTH TECHNOLGY ASSESSMENT

AUSTRALIA: NORMAL SCIENCE AND THE ABSENCE OF REPRESENTATIONAL MEASUREMENT IN HTA EDUCATION

Paul C Langley PhD Adjunct Professor, College of Pharmacy, University of Minnesota, Minneapolis, MN

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ABSTRACT

Health technology assessment (HTA) presents itself as a quantitative science, yet scientific status requires more than numerical analysis, statistical sophistication or institutional acceptance. Normal quantitative science requires attributes to be defined and measured before arithmetic is undertaken, mathematical operations to be admissible for the measurement scales involved, dimensional homogeneity to be maintained, and quantitative claims to be empirically evaluable and falsifiable. Representational measurement provides these foundations. This study assesses whether they are reflected in the Australian HTA, health-economics and outcomes-research program-content knowledge base.

Publicly available university and university-affiliated program content was interrogated using a fixed framework contrasting 17 topics representing the requirements of representational measurement with 20 topics representing contemporary health economics and HTA. The result was categorical. None of the 17 representational-measurement topics was identified as an explicit foundational component of Australian program content, while contemporary HTA methods were extensively represented. The resulting 0/17 versus 20/20 dichotomy constitutes program-content inversion: arithmetic, economic evaluation and modelling are presented without first establishing the measurement conditions required to determine whether their quantitative operations are admissible.

The implications concern the scientific status of contemporary HTA. If measurement does not precede arithmetic, multiplication and division are undertaken without establishing the required ratio properties, and latent and manifest attributes are not subjected to their appropriate measurement requirements, HTA departs from the standards governing normal quantitative science. Utilities, QALYs, cost-per-QALY claims and downstream simulation cannot acquire scientific legitimacy through computational sophistication when their foundational arithmetic is inadmissible.

Australia therefore faces transformation rather than methodological refinement. Representational measurement cannot simply be added to the existing HTA framework; once accepted, it becomes the standard against which that framework must itself be judged. A transition requires HTA to be reconstructed around attribute specification, lawful measurement, admissible arithmetic, linear ratio measurement for manifest attributes, Rasch measurement for latent attributes, and credible, evaluable and falsifiable therapy-impact claims. A nine-unit Maimon Research program provides a structured pathway for this transition. The objective is to bring Australian HTA within the measurement and falsification standards expected of normal quantitative science.

INTRODUCTION

Health technology assessment (HTA) depends upon quantitative claims. These claims are scientifically defensible only when measurement precedes arithmetic and the properties of the measurement scale permit the mathematical operations performed. Multiplication and division require ratio measurement; arithmetic must respect admissible transformations and dimensional homogeneity; and manifest and latent attributes require different approaches to measurement [1 2] .

Previous interrogations of HTA knowledge bases in Australia, Canada and the United States have identified a consistent pattern of measurement inversion [3] . The principles required for lawful measurement receive weak recognition, while utilities, QALYs, cost-effectiveness analysis and simulation modelling are strongly endorsed. Curriculum inversion reproduces the same failure educationally: students are taught the analytical methods of contemporary HTA without first being taught the measurement principles required to determine whether the arithmetic underlying those methods is admissible [4].

The present investigation extends on a previous research center program content study by examining the Australian HTA program-content knowledge base as a whole [5]. Australia provides an important setting because it has a mature and internationally influential HTA environment linking universities, health-economics research centers, government-funded assessment activities and national reimbursement processes. Australian universities undertake research and training in health economics, economic evaluation, outcomes research, health services research, preference assessment, decision modelling and related quantitative methods. These activities contribute directly and indirectly to the evidence base supporting Australian healthcare policy, technology assessment and resource-allocation decisions.

The unit of analysis is therefore not an individual university or research center. It is the publicly available program content through which the Australian HTA knowledge base is expressed and reproduced. This includes university teaching and training, research priorities, methodological descriptions, projects, publications, seminars and the stated analytical activities of relevant university and university-affiliated programs.

Two contrasting bodies of content are assessed. The first represents topics in representational measurement: measurement preceding arithmetic, scales of measurement, admissible transformations, ratio measurement, dimensional homogeneity, the distinction between manifest and latent attributes, linear ratio measurement and Rasch measurement. The second represents topics in contemporary HTA: health economics, economic evaluation, utilities, QALYs, cost-effectiveness analysis, patient-reported outcomes, preference elicitation, decision analysis, simulation modelling and related quantitative methods.

The question is deliberately narrow: does the Australian HTA program-content knowledge base establish representational measurement as the foundation for quantitative claims before applying the arithmetic of contemporary HTA? If the requirements of representational measurement are absent while conventional HTA methods are extensively represented, the result is program-content inversion: an educational and research environment in which arithmetic and modelling proceed without first establishing that the quantities involved support the operations performed.

This distinction is fundamental. Representational measurement is not another methodology that can simply be added to contemporary HTA. It establishes the scientific rules governing the admissibility of the arithmetic itself. Once those rules are applied, every quantitative construct must satisfy them. The Australian review therefore assesses whether lawful measurement provides the foundation for its HTA program content or whether the legacy framework of contemporary HTA continues to occupy that space without it.

FOUNDATIONS OF QUANTITATIVE ANALYSIS

Before examining Australian program content, it is important to identify the scientific principles against which that content is assessed. These are not matters of methodological preference. They are the requirements of representational measurement that determine whether quantitative claims and the arithmetic operations supporting them are admissible.

Two principles are fundamental. First, measurement must precede arithmetic. Numerical operations cannot create measurement where measurement does not exist. Second, the arithmetic performed must be admissible for the measurement scale concerned. Operations involving multiplication, division and ratios require ratio measurement. For claims of therapy impact in HTA, this requires linear ratio measurement for manifest attributes or Rasch measurement for latent attributes.

These requirements establish the boundary between the manipulation of numbers and lawful quantitative measurement. Contemporary Australian HTA, by contrast, is organized around economic evaluation, utilities, QALYs, cost-effectiveness analysis and decision modelling. These methods have over some 40 years become deeply embedded in the Australian HTA environment and in the evidence supporting reimbursement and resource-allocation decisions. Institutional acceptance, however, does not determine measurement status. The prior scientific question remains whether the quantities entering these analyses possess the measurement properties required for the arithmetic performed.

The Australian program-content review therefore asks a straightforward question: does the publicly available Australian HTA teaching and research knowledge base recognize representational measurement as the foundation for quantitative claims, or does it proceed directly to the methods and arithmetic of contemporary HTA without first establishing their measurement admissibility? This is the criterion governing the analysis that follows.

MEASUREMENT BEFORE ARITHMETIC

Before students are introduced to health technology assessment, health economics, cost-effectiveness analysis or decision modelling, they should understand the scientific conditions that determine whether quantitative claims are possible. The governing principle is straightforward: measurement must precede arithmetic. Numbers cannot be manipulated legitimately merely because they have been assigned to observations. The properties of the measurement scale determine which arithmetic operations are admissible.

Representational measurement provides this foundation. The target attribute must first be identified and defined, its measurement properties established, and the appropriate scale constructed. Only then can arithmetic proceed. Multiplication and division require ratio measurement, admissible transformations must be respected, and dimensional homogeneity must be maintained. Reversing this sequence allows arithmetic to precede measurement and produces numerical constructions that cannot be interpreted as lawful quantitative measures.

For HTA claims of therapy impact, the distinction between manifest and latent attributes is fundamental. Manifest attributes are directly observable. Examples include survival time, hospital days, emergency department visits, treatment administrations and walking distance. Where a defined unit and non-arbitrary zero are established, these attributes support linear ratio measurement and the arithmetic permitted by a ratio scale.

Latent attributes, such as pain, fatigue, physical function or need fulfilment, cannot be observed directly. Assigning numbers to questionnaire responses or adding item scores does not establish measurement. A measurement model is required to construct a unidimensional continuum and demonstrate invariant measurement. For this purpose, Rasch measurement provides person-item conjoint measurement, specific objectivity and a logit continuum upon which possession of the latent attribute can be assessed.

The educational requirement can therefore be stated simply. Claims concerning manifest attributes require linear ratio measurement; claims concerning latent attributes require Rasch measurement. Students should understand these requirements before being introduced to utilities, QALYs, cost-effectiveness ratios or simulation models. Numerical constructions do not acquire measurement properties merely through arithmetic, statistical analysis or incorporation into increasingly sophisticated models.

This sequence provides the criterion for assessing Australia's HTA program-content knowledge base. The question is not how sophisticated its teaching, research or modelling may be. It is whether students and researchers are first provided with the measurement principles required to determine whether the arithmetic they subsequently perform is admissible. If representational measurement, ratio measurement and the distinction between manifest and latent attributes are absent while economic evaluation, utilities, QALYs and modelling are extensively represented, the result is program-content inversion.

THE CRITICAL ROLE OF RATIO SCALES

The Australian program-content assessment rests upon a fundamental requirement of representational measurement: arithmetic operations are determined by the properties of the measurement scale. Numerical values cannot legitimately be multiplied, divided or otherwise manipulated merely because numbers have been assigned. Measurement must first be established and the proposed arithmetic must be admissible for the scale concerned.

The distinction between nominal, ordinal, interval and ratio scales is therefore critical. Nominal scales classify; ordinal scales establish order; interval scales provide equal intervals but lack a non-arbitrary zero. Only ratio scales possess both equal units and a non-arbitrary zero and therefore support meaningful ratios and the multiplicative arithmetic required for quantitative claims.

This requirement has immediate consequences for Australian HTA. QALYs multiply health-state values by time; incremental cost-effectiveness ratios divide differences in costs by differences in outcomes; and decision models combine probabilities, utilities, durations and other numerical inputs. Where the quantities involved lack the measurement properties required for these operations, the arithmetic is inadmissible. Subsequent statistical analysis, modelling or simulation cannot correct that prior failure.

For claims of therapy impact, two forms of ratio measurement are relevant. Manifest attributes require linear ratio measurement. Latent attributes require Rasch measurement to construct an invariant quantitative continuum. This distinction provides the foundation for determining whether subsequent arithmetic is admissible.

The Australian assessment therefore applies a straightforward criterion. Does the publicly available HTA program-content knowledge base recognize ratio measurement, admissible arithmetic, dimensional homogeneity and the different measurement requirements of manifest and latent attributes before introducing the quantitative methods of contemporary HTA? Or does it proceed directly to economic evaluation, utilities, QALYs, cost-effectiveness analysis and modelling without first establishing the measurement properties required for their arithmetic?

Ratio measurement is therefore not simply another topic within an HTA curriculum. It establishes the boundary between admissible quantitative analysis and the manipulation of numbers without the measurement properties required to support that analysis.

THE KNOWLEDGE BASE: PROGRAM CONTENT AND COVERAGE

The assessment uses the large language model interrogation framework applied in previous studies of measurement and curriculum inversion. The present analysis differs in one important respect: rather than estimating categorical probabilities of endorsement, it examines whether specified scientific and methodological topics are explicitly represented in the publicly available program content of the Australian HTA knowledge base.

The Australian knowledge base comprises the publicly accessible teaching, research and training environment associated with universities and university-affiliated programs in health economics, health technology assessment, outcomes research, comparative effectiveness research, health services research, pharmacoeconomics and health policy. Material considered includes program descriptions, research priorities, methodological statements, projects, publications, seminars, training activities and related publicly available evidence. The objective is not to evaluate individual investigators or publications, but to characterize the methodological framework represented across Australia as a whole.

As noted above, two contrasting groups of content are examined. The first represents representational measurement. It includes measurement preceding arithmetic, scales of measurement, the axioms of representational measurement, ratio measurement, admissible transformations and arithmetic, dimensional homogeneity, the distinction between manifest and latent attributes, linear ratio measurement for manifest attributes, and Rasch measurement for latent attributes.

The second represents contemporary HTA. It includes health economics, economic evaluation, utilities and multiattribute utility instruments, QALYs, incremental cost-effectiveness ratios, decision analysis, decision trees, Markov models, microsimulation, probabilistic sensitivity analysis and related modelling methods.

The interrogation asks a single question: does the Australian HTA program-content knowledge base establish representational measurement as the foundation for quantitative claims before presenting the analytical methods of contemporary HTA? The criterion is the presence or absence of explicit program content rather than a probability of endorsement.

This distinction is important. Earlier interrogations demonstrated the relative strength with which knowledge bases endorsed measurement inversion and curriculum inversion. Program-content interrogation provides a more direct test. If representational measurement is absent while the methods of contemporary HTA are extensively represented, the result is program-content inversion. Arithmetic, modelling and simulation are taught and applied without first establishing the measurement conditions that determine whether those operations are admissible.

The Australian assessment therefore focuses on a narrow issue: whether the scientific requirements governing measurement are present in the national program-content knowledge base that teaches, researches and transmits contemporary HTA.

ASSESSMENT FRAMEWORK

For this assessment, the Australian program-content knowledge base was defined as the publicly available material describing relevant teaching and training in health economics, HTA, outcomes research, pharmacoeconomics and related fields. Sources included program and curriculum descriptions, courses and modules, syllabi where available, learning objectives, seminars, workshops, teaching resources and associated educational material. The purpose was to establish what students and trainees are expected to encounter across the Australian HTA educational environment, not what individual faculty members may know or address in their independent research.

The relationship between the two components is the critical issue. Contemporary HTA methods cannot be taught independently of the measurement requirements governing their arithmetic. If students are taught that measurement precedes arithmetic, that multiplication and division require ratio measurement, and that manifest and latent attributes require different measurement strategies, they possess the scientific criteria required to judge whether subsequent HTA methods are admissible. Where these foundations are absent, utilities, QALYs, cost-effectiveness ratios and simulation models can be introduced without confronting the measurement properties required for their arithmetic.

Program-content inversion is therefore identified where contemporary HTA methods are extensively represented (20/20 topics) while the prior requirements of representational measurement are absent (0/17 topics). This is more than an imbalance in curriculum content. It reverses the scientific sequence: arithmetic and modelling are introduced before the conditions governing their admissibility have been established.

Program-content inversion places contemporary HTA in direct conflict with the standards of normal quantitative science. A discipline cannot claim scientific status merely because it generates numbers, employs sophisticated models or supports important policy decisions. Scientific quantitative claims require lawful measurement, admissible arithmetic, empirical evaluation and the possibility of falsification. If the foundational requirements of representational measurement are absent while utilities, QALYs, ICERs and simulation models are accepted without demonstrating that their arithmetic is admissible, HTA is operating outside those requirements. In that sense, contemporary HTA occupies a quantitative universe of its own: one in which numerical manipulation has been permitted to substitute for measurement. The 0/17 versus 20/20 program-content inversion is therefore not simply an educational deficiency. It signals disciplinary isolation from the measurement standards governing normal science. HTA is effectively out in left field, sustained by internally accepted conventions rather than the scientific rules that determine whether quantitative claims are legitimate.

The two frameworks are consequently incompatible as foundations for quantitative analysis. Representational measurement requires arithmetic to be constrained by measurement. Once this principle is accepted, every subsequent quantitative method must satisfy its requirements. Ratio-free numerical constructions cannot be exempted simply because they are established components of contemporary HTA. Conversely, when representational measurement is absent, there is no corresponding measurement constraint preventing such constructions from being accepted and taught.

ASSESSMENT RESULTS

PROGRAM CONTENT REVIEW

Jurisdiction
Australia

Knowledge Base
Australian Health Technology Assessment, Health Economics and Outcomes Research Program-Content Knowledge Base

Purpose

This review evaluates the publicly available program content associated with health technology assessment (HTA), health economics, economic evaluation, outcomes research, health services research and related quantitative health research in Australia against a single scientific criterion: whether representational measurement is explicitly recognized as the foundation for quantitative claims before the methods of contemporary HTA are taught or applied.

Particular attention is given to scales of measurement, ratio measurement, admissible transformations and arithmetic, dimensional homogeneity, the distinction between manifest and latent attributes, linear ratio measurement and Rasch measurement. These provide the scientific conditions that must precede arithmetic operations intended to support quantitative claims concerning therapy impact.

Programs and Content Reviewed

The review treats Australia as a single national program-content knowledge base. Publicly available material was examined from major university and university-affiliated centers, groups, courses and programs engaged in HTA, health economics, economic evaluation and related fields.

The knowledge base includes material associated with, among others:

- Center for Health Economics Research and Evaluation (CHERE), University of Technology Sydney
- Center for Health Economics, Monash University
- Melbourne Health Economics and Melbourne Health Technology and Value Assessment Collaboration, University of Melbourne
- Adelaide Health Technology Assessment, Adelaide University
- Center for Applied Health Economics, Griffith University
- Health Economics Research and Modelling Unit and associated health-services research, University of Queensland
- Australian National University Health Economics Group
- Macquarie University Center for the Health Economy
- UNSW School of Population Health health-economics program
- Flinders University health-economics activities
- University of Western Australia economic-evaluation teaching
- Other identifiable Australian university teaching and research activities in health economics, pharmacoeconomics, outcomes research and economic evaluation.

These programs demonstrate substantial engagement with economic evaluation, cost-effectiveness, cost-utility analysis, HTA, preference research, modelling and resource allocation. CHERE explicitly identifies economic evaluation, HTA and discrete-choice methods; Adelaide HTA undertakes comparative effectiveness and cost-effectiveness assessment and offers an HTA course; Melbourne provides dedicated HTA, cost-effectiveness and cost-utility training; Griffith identifies HTA, economic evaluation and modelling; and Monash undertakes HTA work for government and research in preferences and priority setting.

TABLE 1: REPRESENTATIONAL MEASUREMENT

Topic	Australian program-content finding
Representational measurement	No evidence identified
Scales of measurement as constraints on arithmetic	No evidence identified
Measurement precedes arithmetic	No evidence identified
Axioms of representational measurement	No evidence identified
Ratio measurement as prerequisite for multiplication and division	No evidence identified
True zero and equal units	No evidence identified

Topic	Australian program-content finding
Admissible transformations	No evidence identified
Admissible arithmetic by scale type	No evidence identified
Dimensional homogeneity	No evidence identified
Manifest and latent attributes as distinct measurement classes	No evidence identified
Linear ratio measurement for manifest attributes	No evidence identified
Possession of latent attributes	No evidence identified
Rasch measurement as requirement for latent attributes	No evidence identified
Person–item conjoint measurement	No evidence identified
Specific objectivity and invariance	No evidence identified
Rasch logit ratio measurement for latent attributes	No evidence identified
Two admissible ratio measures for therapy impact	No evidence identified

The absence of Rasch as a foundational HTA measurement framework should be distinguished from occasional Australian applications of Rasch modelling. Publicly identifiable examples use Rasch analysis in instrument development or item reduction, including work associated with Monash and Griffith. These examples do not establish representational measurement or Rasch measurement as the prior organizing framework governing HTA arithmetic.

TABLE 2: CONTEMPORARY HEALTH ECONOMICS AND HTA FRAMEWORK

Topic	Explicitly represented	Program evidence
Health economics	Yes	Multiple national university programs
Health technology assessment	Yes	Adelaide, Melbourne, Griffith, CHERE, Monash, UQ and others
Economic evaluation	Yes	Broadly represented
Cost-effectiveness analysis	Yes	Explicit teaching and research
Cost-benefit analysis	Yes	UNSW, UWA and other programs
Cost-utility analysis	Yes	Melbourne, UWA, UNSW and related programs
Health utility measurement	Yes	Economic-evaluation teaching and outcomes research
QALYs	Yes	Economic evaluation and preference research
Pharmacoeconomics	Yes	Pharmacy and health-economics activities

Topic	Explicitly represented	Program evidence
Patient-reported outcomes / quality of life	Yes	Outcomes and preference research
Preference elicitation	Yes	Monash, CHERE and related groups
Resource allocation / priority setting	Yes	Multiple programs
Value-for-money assessment	Yes	CHERE, Adelaide, Melbourne, UNSW and others
Decision analysis	Yes	Economic-evaluation and modelling programs
Decision-tree modelling	Yes	HTA/economic-evaluation teaching
Markov modelling	Yes	Modelling and economic-evaluation activities
Simulation / microsimulation	Yes	Melbourne, Flinders and related programs
Probabilistic sensitivity / uncertainty analysis	Yes	Economic-evaluation teaching
Value-of-information analysis	Represented within advanced economic evaluation	Australian HTA/economic-evaluation research
Budget impact / healthcare costs	Yes	Applied HTA and health-economics programs
Real-world evidence / data analysis	Yes	Multiple health-services and HEOR programs
Policy application of economic evaluation	Yes	Major national emphasis

The national evidence is extensive. Adelaide HTA explicitly undertakes economic modelling and cost-utility work and supports government technology-funding decisions. Melbourne teaches cost-effectiveness, cost-utility analysis, uncertainty, modelling and health economics for HTA. Griffith identifies economic evaluation, HTA and economic modelling among its core capabilities. UNSW explicitly lists cost-effectiveness, cost-benefit and cost-utility analysis. UWA's economic-evaluation unit includes cost-effectiveness, cost-utility, sensitivity analysis, discounting, willingness to pay and health-state utility measurement. Flinders has expertise in long-term cost-effectiveness and simulation modelling.

Assessment

The Australian program-content knowledge base presents a large, mature and institutionally embedded framework for contemporary HTA and health economics. Universities and research centers provide teaching and research in economic evaluation, cost-effectiveness and cost-utility analysis, preference elicitation, health-state valuation, decision analysis, simulation, uncertainty analysis, healthcare costs, priority setting and resource allocation. Several centers also work directly with governments and HTA processes.

Against the representational-measurement criterion applied here, however, the contrast is categorical. In the publicly available program material reviewed, no evidence was identified that representational measurement provides the prior organizing framework for Australian HTA teaching and research. No corresponding program-level requirement was identified that students or researchers establish the scale properties of an attribute, determine admissible transformations, establish ratio measurement before multiplication or division, or demonstrate dimensional homogeneity before undertaking quantitative analysis.

The same applies to the distinction between manifest and latent attributes. Australian researchers do employ Rasch methods in some instrument-development work, but this is different from teaching Rasch measurement as the required measurement framework for latent therapy-impact attributes. The public evidence reviewed did not identify person–item conjoint measurement, specific objectivity, possession of a latent attribute or Rasch logit measurement as foundational requirements that must precede HTA claims.

The contrast with contemporary HTA content is therefore striking. Economic evaluation, cost-effectiveness, cost-utility analysis, utility measurement, QALYs, preference research, decision modelling and simulation are explicitly embedded across the Australian knowledge base, while the representational-measurement topics used in this assessment are not visibly established as their scientific foundation.

The result is program-content inversion. The national teaching and research framework develops proficiency in the arithmetic and modelling of contemporary HTA without first providing the measurement framework required to determine whether that arithmetic is admissible. The finding for program inversions means that HTA program content and application are outside the lawful measurement standards of normal science.

Judged by normal science, this finding is more consequential than an imbalance in subject coverage. Representational measurement cannot simply be inserted as another methodological topic while the remainder of the HTA framework continues unchanged. Once students are taught that measurement precedes arithmetic, that multiplication and division require ratio measurement, and that arithmetic operations are constrained by scale properties, utilities, QALYs and cost-per-QALY claims must themselves be assessed against those requirements.

To facilitate this transition to normal science, Maimon Research has developed a comprehensive nine-unit program that reconstructs health technology assessment from the foundations of representational measurement. Its purpose is not to supplement contemporary HTA with another methodological topic, but to provide the scientific framework required to replace a legacy system founded upon inadmissible arithmetic. The program begins with the non-negotiable principle that measurement precedes arithmetic and develops systematically the requirements for lawful quantitative claims: attribute specification, scales of measurement, admissible transformations, dimensional homogeneity, the distinction between manifest and latent attributes, linear ratio measurement for manifest attributes, Rasch measurement and possession for latent attributes, and the formulation of credible, evaluable and falsifiable claims of therapy impact. It then demonstrates how these principles reshape therapy evaluation, health economics and formulary assessment. The program therefore provides faculty, researchers and students with both the scientific foundation and the practical pathway required to move HTA into conformity with the standards of normal science. To our knowledge, it is the only program developed specifically to support this transition from contemporary HTA to a representational measurement paradigm. A complete description of the nine-unit program, together with supporting materials and implementation guidance, is detailed on the Maimin Research website [6] .

CONCLUSION: HTA OUTSIDE NORMAL SCIENCE

The Australian program-content review reveals a categorical divide. The methods of contemporary health technology assessment are extensively represented across the publicly available Australian program-content knowledge base, while the principles of representational measurement required to establish lawful quantitative claims are absent. The 0/17 versus 20/20 finding is therefore more than program-content inversion. Under the scientific criteria applied in this study, it places contemporary HTA outside the measurement standards of normal quantitative science.

This is the critical conclusion. Normal quantitative science does not begin with numbers, models or statistical procedures. It begins with measurement. The target attribute must be defined, the properties required for measurement established, and the arithmetic restricted to operations admissible for the resulting scale. Multiplication and division require ratio measurement; dimensional homogeneity must be maintained; manifest attributes require appropriate linear ratio measures; and latent attributes require a measurement model capable of establishing the required quantitative structure. These requirements are not optional additions to quantitative analysis. They determine whether quantitative analysis is scientifically possible.

Contemporary HTA has developed largely outside this framework. Utilities and multiattribute utility scores are treated as quantities upon which arithmetic may be performed without first establishing the required measurement properties. They are multiplied by time to construct QALYs; differences between QALYs are calculated; incremental costs are divided by those differences; and the resulting cost-per-QALY claims are propagated through decision models, reference-case simulations and probabilistic sensitivity analyses. If the required measurement properties are absent at the beginning, none of this downstream sophistication repairs the failure. Inadmissible arithmetic remains inadmissible arithmetic.

The implication is stark. Contemporary HTA occupies an isolated quantitative domain in which internally accepted conventions have substituted for the measurement requirements governing normal science. Its models may be mathematically elaborate, its analyses reproducible computationally and its methods institutionally entrenched, but none of these establishes scientific measurement. A discipline cannot escape the requirements of measurement because its conventions have been accepted for forty years. On the criteria examined here, Australian HTA is effectively out in the cold of non-science: producing numerical claims within a framework that has not established the scientific conditions required to interpret those numbers as lawful quantities.

The significance extends directly to education. Australian students can become highly proficient in health economics, pharmacoeconomics, economic evaluation, cost-effectiveness analysis and decision modelling without first encountering the question that normal quantitative science requires them to ask: are these quantities measures, and is the arithmetic admissible? Program-content inversion removes the intellectual framework necessary to pose that question. Students consequently inherit the methods of the legacy HTA framework without simultaneously receiving the scientific standards required to test its foundations.

Nor is the problem confined to universities. Australian academic centers provide research, methods, expertise and trained personnel to the wider national HTA environment. Their intellectual framework therefore feeds into technology assessment, reimbursement, medicines evaluation and resource-allocation decisions. Program-content inversion becomes a mechanism through which measurement inversion can be reproduced across the wider Australian HTA system. What begins as the absence of representational measurement in program content ultimately affects the scientific status of the quantitative claims used to inform healthcare decisions.

The response cannot be another refinement of contemporary HTA. Adding a lecture on measurement theory while retaining utilities, QALYs and cost-per-QALY modelling unchanged would evade the central issue. Representational measurement is not another technique within the HTA toolkit; it determines whether the tools already there are scientifically admissible. Once measurement precedes arithmetic is accepted, every existing quantitative construct must be reassessed against that requirement. Those that fail cannot retain scientific legitimacy merely because they are familiar, institutionally endorsed or embedded in reimbursement practice.

Australia therefore faces a transition from a legacy framework operating outside the measurement requirements of normal science to a substantive HTA paradigm governed by them. The objective is not to abandon HTA but to bring it back within science: define the attribute, establish lawful measurement, distinguish manifest from latent attributes, employ the appropriate measurement model, restrict arithmetic to admissible operations, and formulate therapy-impact claims that are credible, evaluable, replicable and falsifiable. The challenge is no longer whether contemporary HTA should be improved. It is whether Australia will continue to defend an isolated quantitative framework or undertake the transformation required for HTA to re-enter the domain of normal quantitative science.

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REFERENCES

[1] Stevens S. On the Theory of Scales of Measurement. *Science*. 1946;103(2684):677-80

[2] Krantz D, Luce R, Suppes P, Tversky A. Foundations pf Measurement Vol 1: Additive and Polynomial Representations. New York: Academic Press, 1971

[3] Australia: Academic research centers endorse the absence of measurement in health technology assessment. Logit Working Paper No 33. https://maimonresearch.com/logit-working-paper-no-33/

[4] Australia: The endorsement of curriculum inversion. Logit Working Paper No 1540. https://maimonresearch.com/logit-working-paper-no-1540-july-2026/

[5] Australia: University research centers and the absence of measurement in HTA education. Logit Working Paper 1789. https://maimonresearch.com/logit-working-paper-no-1789-july-2026/

[6]Maimon Research. HTA Reconstruction. https://maimonresearch.com/hta-reconstruction-program-and-fees/