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REPRESENTATIONAL MEASUREMENT FAILURE IN HEALTH TECHNOLGY ASSESSMENT

FRANCE: THE ENDORSEMENT OF CURRICULUM INVERSION IN THE HAUTE AUTORITÉ DE SANTÉ (HAS)

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ABSTRACT

This Logit Working Paper examines the educational foundations of French health technology assessment (HTA) through an interrogation of the curriculum knowledge base of the Haute Autorité de Santé (HAS). It is the companion study to France: The Endorsement of Measurement Inversion in the Haute Autorité de Santé (HAS)*, which concluded that the publicly accessible methodological knowledge base of HAS institutionalizes measurement inversion by endorsing utilities, QALYs, cost-effectiveness analysis, and reference-case modelling while giving little recognition to the scientific principles of representational measurement. The present study addresses the complementary question of how this methodological framework is communicated to successive generations of HTA practitioners.*

Curriculum interrogation applies a fixed set of ten canonical statements representing the minimum scientific competencies required for lawful quantitative assessment of therapy impact. These encompass specification of the target attribute, the principal scales of measurement, representational measurement, unidimensionality, the distinction between manifest and latent attributes, ratio measurement, Rasch measurement for latent constructs, and the requirement that quantitative claims be prospectively evaluable, replicable, and capable of falsification. Together, these concepts define the educational foundations of a measurement-based approach to HTA.

The interrogation demonstrates a consistent pattern of curriculum inversion. The concepts required to evaluate the scientific legitimacy of accepted HTA methods receive uniformly weak endorsement, while the curriculum places primary emphasis on comparative effectiveness assessment, utilities, QALYs, economic evaluation, decision modelling, and reimbursement methodology. Students and practitioners are therefore introduced to established analytical techniques before acquiring the scientific principles necessary to determine whether those techniques satisfy the requirements of quantitative measurement. Curriculum inversion emerges as the educational mechanism through which measurement inversion is reproduced and institutionalized within French HTA.

Particular attention is given to the absence of explicit instruction on the distinction between manifest and latent attributes and the corresponding forms of ratio measurement required for each. The paper demonstrates that this omission removes one of the essential conceptual foundations of measurement-based HTA and explains the near-complete absence of Rasch measurement from the HAS educational framework. As a consequence, latent constructs such as quality of life, symptom burden, treatment satisfaction, and patient-reported outcomes are represented through scores, utilities, and composite indices rather than scientifically validated measures of attribute possession.

The paper concludes that reconstruction of French HTA cannot be achieved solely through methodological refinement. Educational reconstruction must accompany methodological reconstruction. Representational measurement must become the organizing principle of HTA education, with measurement preceding arithmetic, attributes preceding models, and evaluable, replicable, and falsifiable therapy-impact claims replacing reliance on established

methodological convention. Only through such a transition can French HTA satisfy the standards expected of a quantitative scientific discipline.

INTRODUCTION

The companion Logit Working Paper, *France: The Endorsement of Measurement Inversion in the Haute Autorité de Santé (HAS)*, concluded that the publicly accessible methodological knowledge base of the Haute Autorité de Santé (HAS) endorses a framework in which arithmetic is routinely applied without first establishing the measurement properties of the quantities being manipulated [1]. Using a 24 statement interrogation derived from the axioms of representational measurement, the study demonstrated that propositions defining the scientific foundations of measurement received consistently weak endorsement, while propositions supporting utilities, QALYs, cost-effectiveness ratios, and reference-case modelling received consistently strong endorsement. The conclusion was that measurement inversion has become institutionalized within the French national HTA framework.

The present study addresses a different, but closely related, question. If the methodological knowledge base of HAS embodies measurement inversion, what conceptual framework is communicated to those who learn HTA through HAS guidance? HAS is more than France's national HTA agency. Through its methodological guidance, economic evaluation manuals, committee documentation, submission requirements, technical reports, explanatory publications, workshops, and public presentations, it provides the principal educational resource through which manufacturers, consultants, academic researchers, committee members, and health economists acquire their understanding of French HTA methodology. Although HAS is not a university, it performs an important educational function. It defines the analytical concepts, methodological standards, and professional expectations that shape HTA practice throughout France.

The focus of the present paper is therefore curriculum inversion. Whereas measurement inversion concerns the relationship between measurement and arithmetic within HTA methodology, curriculum inversion concerns the sequence in which those concepts are communicated and learned. A scientifically coherent educational framework would first establish the principles of representational measurement, the specification of target attributes, the principal scales of measurement, admissible arithmetic, the distinction between manifest and latent attributes, linear ratio and Rasch logit ratio measurement, and the requirement that therapy-impact claims be prospectively evaluable, replicable, and capable of falsification. Only after these foundations had been established would analytical methods such as utilities, QALYs, cost-effectiveness analysis, decision modelling, and economic evaluation be introduced.

The central question addressed by this interrogation is therefore straightforward: does the publicly accessible educational knowledge base of HAS expose HTA practitioners to the scientific principles required to evaluate accepted HTA methods, or does it primarily train them in the application of those methods without first establishing their measurement foundations? If the latter is observed, the consequence is curriculum inversion. The educational environment becomes one in which methodological conventions are transmitted before students and practitioners are equipped to determine whether those conventions satisfy the requirements of quantitative science.

In this way, curriculum inversion becomes the mechanism through which measurement inversion is reproduced across successive generations of French HTA practitioners.

The interrogation reveals a consistent and unmistakable pattern of curriculum inversion within the HAS educational knowledge base. Across the ten canonical statements, the scientific concepts that should form the intellectual foundation of health technology assessment receive uniformly weak endorsement. Fundamental principles—including specification of the target attribute, the principal scales of measurement, representational measurement, the requirement that measurement precede arithmetic, unidimensionality, the distinction between manifest and latent attributes, Rasch measurement for latent constructs, and the requirement that therapy-impact claims be falsifiable are either weakly represented or effectively absent. At the same time, the HAS knowledge base places strong emphasis on the practical application of comparative effectiveness assessment, utilities, QALYs, cost-effectiveness analysis, economic evaluation, and decision modelling. The curriculum therefore teaches practitioners how to apply established HTA methods before equipping them with the scientific principles required to determine whether those methods can support lawful quantitative claims. In this respect, the findings closely parallel those of the companion paper on measurement inversion. There, the HAS methodological framework was shown to endorse analytical methods that fail the axioms of representational measurement. Here, the educational knowledge base is shown to reproduce those same assumptions by transmitting methodological practice without first establishing its scientific foundations. Curriculum inversion thus emerges as the educational mechanism through which measurement inversion is institutionalized and perpetuated within French HTA.

CURRICULUM INVERSION

Curriculum inversion occurs when a curriculum teaches the application of quantitative methods while failing to teach the measurement principles that determine whether those methods are scientifically legitimate. In a scientifically coherent curriculum, measurement precedes arithmetic. Students first learn the nature of attributes, the requirements of representational measurement, the distinctions among nominal, ordinal, interval and ratio scales, and the conditions necessary for valid quantitative claims for manifest and the application of Rasch models for latent attributes [2] [3] [4]. Only then are they introduced to the arithmetic, statistical and modelling procedures that depend upon those measurement properties. Curriculum inversion reverses this sequence. Students learn how to calculate, model and analyze before they learn how to determine whether the quantities entering those analyses are measures. Arithmetic becomes detached from measurement and numerical manipulation is treated as though it were equivalent to quantitative science.

The consequences are profound. A curriculum affected by inversion reproduces a professional culture in which measurement is assumed rather than demonstrated. Concepts such as unidimensionality, dimensional homogeneity, admissible arithmetic, manifest and latent attributes, ratio measurement and Rasch measurement either disappear entirely or are treated as peripheral concerns. Students become proficient in the techniques of economic evaluation, utility assessment, QALY construction and simulation modelling without acquiring the conceptual tools necessary to evaluate the legitimacy of those methods. The result is that the curriculum not only fails to identify measurement errors but actively reproduces them across successive generations of researchers, analysts and decision makers. Curriculum inversion therefore serves as the educational mechanism

through which measurement inversion becomes institutionalized within a discipline. In HTA this serves to support administrative decisions for therapy pricing and access.

For this reason, curriculum assessment emerges as a critical component of HTA reconstruction. The objective is not simply to determine whether students are exposed to contemporary HTA methods. Rather, it is to determine whether they are exposed to the foundational concepts that make the evaluation of those methods possible. A curriculum that emphasizes modelling, economic evaluation and decision analysis while neglecting measurement theory will inevitably reproduce the same conceptual limitations observed in current HTA practice.

The curriculum interrogations undertaken across French HTA research centers provide compelling support for this interpretation [5]. While there is evidence that students and researchers are introduced to outcomes assessment, target attributes and scientific claims, there is little evidence of systematic exposure to scales of measurement, the axioms of representational measurement, unidimensionality, latent attribute measurement or ratio measurement. The concepts most frequently absent from curriculum coverage are precisely those concepts most frequently absent from HTA practice. The relationship is unlikely to be coincidental.

The imperative of measurement inversion therefore extends beyond criticism of existing methods. It points directly to the need for educational reconstruction. If HTA is to move toward a framework based on lawful measurement, evaluable claims and empirical falsification, then curriculum reform must accompany methodological reform. The widespread and consistent pattern of measurement inversion revealed by the interrogations suggests that reconstruction cannot begin with policy guidance or analytical techniques alone. It must begin with the curriculum. Until students and researchers are introduced to the foundations of measurement science, the conditions that created measurement inversion will continue to be reproduced throughout the HTA community.

THE HAS CURRICULUM KNOWLEDGE BASE

The first step in any large language model (LLM) interrogation is to define the knowledge base to be examined. The validity of the interrogation depends upon ensuring that the knowledge base accurately represents the educational environment through which concepts, methods, and professional standards are communicated to those who practice health technology assessment (HTA). A curriculum knowledge base is considerably broader than a formal university syllabus. It encompasses the complete body of publicly accessible educational and methodological resources through which an institution communicates what practitioners are expected to know, understand, and apply. In the case of the Haute Autorité de Santé (HAS), these resources constitute the principal educational framework supporting HTA practice in France.

For the purposes of the present interrogation, the HAS curriculum knowledge base is defined as the publicly accessible body of educational, methodological, and explanatory materials through which HAS communicates its approach to HTA. This includes methodological guidance, economic evaluation manuals, CEESP guidance documents, Transparency Committee documentation, CNEDiMTS publications, submission requirements, technical reports, consultation papers, explanatory documents, workshops, seminar materials, methodological updates, presentations, policy statements, and other publicly available resources designed to

explain or support HTA practice. Collectively, these materials define the concepts, analytical methods, and professional expectations encountered by manufacturers, consultants, academic researchers, health economists, committee members, postgraduate students, and others seeking to understand or apply French HTA methodology.

The significance of this knowledge base extends well beyond the activities of HAS itself. National HTA agencies perform an important educational function by defining what constitutes acceptable evidence, appropriate analytical methods, and good professional practice. Their methodological guidance is widely adopted within universities, research institutes, consultancy organizations, pharmaceutical companies, and professional training programmes. Consequently, the concepts emphasized by HAS become embedded within the wider intellectual culture of French HTA, influencing not only reimbursement submissions but also the education of future practitioners and researchers. The HAS curriculum knowledge base therefore represents a national educational resource whose influence extends throughout the French HTA community.

A curriculum designed to support scientifically defensible quantitative evaluation would be expected to expose learners to the foundational principles that precede all quantitative reasoning. These include specification of the target attribute, recognition of the principal scales of measurement, the axioms of representational measurement, the requirement that measurement precede arithmetic, unidimensionality, dimensional homogeneity, the distinction between manifest and latent attributes, the different measurement requirements for each class of attribute, and the necessity for therapy-impact claims to be prospectively evaluable, independently replicable, and capable of falsification. These concepts are not optional additions to HTA methodology. They represent the scientific foundations upon which lawful quantitative claims depend.

The purpose of the present interrogation is therefore not to evaluate individual training events, lecturers, or educational programmes provided by HAS. Rather, it is to determine whether the publicly accessible educational knowledge base systematically exposes practitioners to the scientific principles required to evaluate accepted HTA methods before those methods are taught and applied. The central question is straightforward: does the HAS curriculum knowledge base prepare practitioners to understand why particular analytical methods are scientifically legitimate, or does it primarily prepare them to apply those methods without first establishing their measurement foundations? The answer provides an indication of whether the educational environment supports measurement-based HTA or whether it embodies curriculum inversion, thereby reproducing and reinforcing the measurement inversion identified in the companion assessment of the HAS methodological knowledge base.

INTERROGATING THE HAS CURRICULUM KNOWLEDGE BASE

The objective of large language model (LLM) curriculum interrogation differs from that of previous HTA knowledge-based practice assessments. Earlier interrogations focused on whether institutions recognized the requirements of representational measurement and the standards necessary for quantitative claims. Curriculum interrogation asks a different question. Are faculty, students and researchers exposed to the concepts necessary to understand and apply those standards? The focus shifts from methodological outputs to educational inputs. Rather than

examining what faculty, students and researchers do, attention is directed to what they are taught and what they know.

The importance of this distinction should not be underestimated. Educational programs do not merely transmit technical skills. They define the conceptual framework through which future practitioners understand evidence, measurement and scientific inquiry. Concepts that are absent from the curriculum are unlikely to emerge spontaneously in research practice. Equally, concepts that are emphasized repeatedly become part of the intellectual assumptions that shape subsequent analysis have never been systematically incorporated into HTA teaching and research training.

For this reason, the curriculum interrogation was designed around a series of canonical statements intended to identify the presence or absence of foundational measurement concepts. These statements were deliberately elementary. The purpose was not to assess advanced methodological knowledge but to determine whether faculty, students and researchers are likely to encounter the principles that underpin lawful quantitative claims. The resulting framework begins with the concept of an attribute as the object of measurement and proceeds through target attribute specification, scales of measurement, representational measurement, unidimensionality, manifest and latent attributes, ratio measurement and falsifiable claims. Together, these statements define the minimum intellectual foundations required for a measurement-based approach to therapy assessment in education.

These statements are:

- **An attribute is the specific outcome of interest in a therapy assessment.**
- **Every therapy assessment begins with specification of the target attribute.**
- **The principal scales of measurement (nominal, ordinal, interval and ratio) have different properties and support different forms of analysis.**
- **The measurement status of a target attribute must be established before quantitative claims can be advanced.**
- **The axioms of representational measurement underpin quantitative claims.**
- **Attributes must be demonstrated to be unidimensional before measurement is possible.**
- **A manifest attribute is directly observable and capable of supporting empirical observation.**
- **A latent attribute is not directly observable and requires a measurement model to estimate possession of the attribute.**
- **Manifest and latent attributes require different forms of ratio measurement.**
- **Therapy impact claims must be falsifiable.**

These ten statements form a logical sequence:

Attribute → Target Attribute → Scales of Measurement → Measurement Status → Representational Measurement → Unidimensionality → Manifest Attribute → Latent Attribute → Ratio Measurement → Falsifiable Claims

Together they define the minimum curriculum content required for a measurement-based approach to HTA and provide the framework for evaluating curriculum coverage in Canada HTA research centers.

The categorical probabilities reported in this assessment are intended as indicators of the extent to which a concept is represented within the curriculum knowledge base. They should not be interpreted as precise statistical estimates but as measures of the likelihood that a student, researcher or professional exposed to that knowledge base would encounter, recognize and subsequently endorse the canonical statement. In practical terms, the probability reflects the visibility and prominence of a concept within the educational environment associated with a research center or policy agency.

A high probability indicates that the concept is well represented within curriculum materials, research outputs and educational activities and is therefore likely to be familiar to students and researchers. Conversely, a low probability suggests that the concept is absent, only weakly represented, or occupies a peripheral position within the curriculum knowledge base. Students exposed to such an environment would therefore be unlikely to recognize the concept as an important component of HTA education and practice.

The probabilities should be viewed comparatively rather than in isolation. Their principal value lies in identifying patterns of curriculum coverage across institutions and concepts. In particular, low probabilities associated with scales of measurement, representational measurement, unidimensionality and ratio measurement indicate that these topics are unlikely to form a substantial part of the educational experience of the average student. The resulting profile provides an indication of curriculum strengths, deficiencies and potential areas for reconstruction.

HAS AND CURRICULUM INVERSION

The curriculum interrogation of HAS reveals a pattern that is now familiar across the health technology assessment landscape (Table 1). Students and practitioners are introduced to utilities, QALYs, simulation models, and other accepted components of the HTA reference case before they are introduced to the concepts required to evaluate whether these constructs satisfy the standards of measurement. The curriculum teaches the products of the framework before teaching the criteria by which the framework itself should be judged. As a result, accepted methodologies are presented as established analytical tools rather than as propositions whose measurement status must first be demonstrated.

TABLE 1: CURRICULUM CONTENT ENDORSEMENT: HAS KNOWLEDGE BASE

CANONICAL STATEMENT	CATEGORICAL PROBABILITY	NORMALIZED LOGIT
An attribute is the specific outcome of interest in a therapy assessment	0.20	-1.50
Every therapy assessment begins with specification of the target attribute	0.10	-2.00
The principal scales of measurement (nominal, ordinal, interval and ratio) have different properties and support different forms of analysis	0.15	-1.75
The measurement status of a target attribute must be established before quantitative claims can be advanced	0.10	-2.00
The axioms of representational measurement underpin quantitative claims	0.05	-2.50
Attributes must be demonstrated to be unidimensional before measurement is possible	0.15	-1.75
A manifest attribute is directly observable and capable of supporting empirical observation	0.25	-1.25
A latent attribute is not directly observable and requires a measurement model to estimate possession of the attribute	0.10	-2.00
Manifest and latent attributes require different forms of ratio measurement	0.05	-2.50
Therapy impact claims must be falsifiable	0.20	-1.50

The interrogation begins with the proposition that an attribute is the specific outcome of interest in a therapy assessment. This receives only weak endorsement within the HAS curriculum knowledge base. Although clinical outcomes, patient-reported outcomes, and economic endpoints are discussed extensively, there is little indication that the curriculum presents the attribute itself as the scientific starting point for quantitative inquiry. Closely related is the proposition that every therapy assessment begins with specification of the target attribute**.** Again, endorsement is weak. Rather than beginning with the precise attribute to be measured, the educational emphasis falls upon comparative assessment, economic evaluation, utilities, QALYs, modelling, and reimbursement methodology. Methods therefore precede measurement.

This inversion is reinforced by the limited recognition given to the proposition that the principal scales of measurement nominal, ordinal, interval, and ratio possess different mathematical properties and support different forms of analysis**.** The curriculum assumes numerical competence but provides little evidence that students are expected to distinguish between the principal measurement scales or appreciate that each permit only particular forms of arithmetic. Closely associated with this omission is the proposition that the measurement status of the target attribute must be established before quantitative claims can be advanced. This receives one of the weakest endorsement profiles in the interrogation. Instead of first establishing whether an attribute has been

measured on an admissible scale, the curriculum proceeds directly to analytical techniques that assume such measurement has already been achieved.

The same pattern is evident in the proposition that the axioms of representational measurement underpin quantitative claims**.** The interrogation indicates almost no recognition of representational measurement as the scientific foundation of HTA. Concepts such as admissible transformations, dimensional homogeneity, cancellation, solvability, and the lawful application of arithmetic are effectively absent from the educational framework. Consequently, practitioners are introduced to sophisticated analytical methods without first acquiring the scientific principles that determine whether those methods are mathematically legitimate.

Similarly, the proposition that attributes must be demonstrated to be unidimensional before measurement is possible receives only limited endorsement. While individual outcome measures are discussed, there is little indication that the curriculum explains why measurement requires a single underlying attribute or why multidimensional constructs cannot simply be aggregated and treated as quantitative measures. Composite indices are therefore liable to be accepted without critical examination of their measurement properties.

The interrogation provides slightly stronger endorsement for the proposition that a manifest attribute is directly observable and capable of supporting empirical observation. This reflects the emphasis placed upon observable clinical outcomes such as mortality, adverse events, hospital admissions, and treatment persistence. Nevertheless, the distinction between observation and measurement is rarely made explicit. More importantly, the curriculum gives very weak recognition to the complementary proposition that a latent attribute is not directly observable and requires a measurement model to estimate possession of the attribute. Patient-reported outcomes and health-related quality of life are widely employed within HTA, yet there is little evidence that students are taught why latent attributes require formal measurement models or why Rasch measurement occupies a unique position in constructing lawful measures of latent variables.

Perhaps the most revealing finding concerns the proposition that manifest and latent attributes require different forms of ratio measurement. This receives the weakest endorsement of all ten curriculum statements. The distinction between linear ratio measurement for manifest attributes and Rasch logit ratio measurement for latent attributes is effectively absent from the HAS educational knowledge base. Consequently, fundamentally different forms of measurement are treated as though they were conceptually interchangeable, removing one of the central distinctions upon which scientific HTA depends.

Finally, the proposition that therapy-impact claims must be falsifiable also receives only limited endorsement. Although the HAS curriculum places considerable emphasis upon evidence appraisal and informed decision-making, there is comparatively little recognition that quantitative claims should be prospectively specified, empirically testable, independently replicable, and capable of refutation. The emphasis remains on evidence synthesis and methodological application rather than on the continuous empirical testing of therapy-impact claims.

Taken together, these findings reveal a coherent pattern of curriculum inversion. The HAS educational knowledge base introduces students and practitioners to the techniques of

contemporary HTA—comparative effectiveness, utilities, QALYs, economic evaluation, decision modelling, and reimbursement methodology—without first establishing the scientific principles that determine whether these techniques can support lawful quantitative claims. The curriculum therefore reproduces the measurement inversion identified in the companion interrogation of the HAS methodological knowledge base. Rather than preparing practitioners to evaluate the scientific legitimacy of accepted HTA methods, it prepares them to apply those methods. Curriculum inversion thus becomes the educational mechanism through which measurement inversion is institutionalized and transmitted throughout the French HTA community.

MANIFEST AND LATENT ATTRIBUTES

A central finding of the HAS curriculum interrogation is the absence of any explicit framework distinguishing manifest from latent attributes and the corresponding measurement requirements that follow from this distinction. This omission is important because the manifest-latent distinction is one of the foundational concepts of representational measurement. Without it, there is no coherent basis for determining how therapy outcomes should be assessed, what constitutes an admissible measure, or whether a quantitative claim can be justified.

Manifest attributes are directly observable. Their existence and magnitude can be established through empirical observation without the need for an intervening measurement model. Examples include survival time, hospital admissions, emergency department visits, medication possession, treatment discontinuation, adverse events, laboratory values, and health care resource utilization. These attributes are observable phenomena that can be counted, timed, or otherwise recorded directly. When properly specified, manifest attributes can support linear ratio measures characterized by a meaningful zero and admissible arithmetic operations. The measurement challenge is therefore relatively straightforward: define the attribute, establish the unit of observation, specify the observation period, and evaluate the resulting claim empirically.

Latent attributes present a fundamentally different problem. Attributes such as pain, fatigue, anxiety, depression, functional status, quality of life, treatment satisfaction, confidence, and need fulfilment are not directly observable. They cannot be counted or measured in the same manner as hospital admissions or survival time. Their existence must be inferred from observable indicators, typically responses to questionnaire items or other structured observations. Consequently, latent attributes require a measurement model capable of estimating possession of the attribute that recognizes the axioms of representational measurement.

The significance of this distinction is that manifest and latent attributes cannot be treated identically. They require different measurement strategies and different forms of ratio measurement. Manifest attributes support linear ratio scales. Latent attributes require a Rasch-derived logit ratio scale capable of demonstrating unidimensionality, invariance, and lawful measurement. This distinction is fundamental because it determines whether a quantitative claim regarding therapy impact is scientifically defensible.

The interrogation suggests that HAS materials do not recognize this distinction as an organizing principle for HTA education. Instead, outcomes appear to be grouped together under broad categories such as patient-reported outcomes, quality of life, clinical effectiveness, utility

assessment, and value measurement. While these categories may be useful descriptively, they do not distinguish between attributes that are directly observable and those that require a measurement model. As a result, the measurement requirements associated with each type of attribute remain obscured.

This omission has important consequences. Once the distinction between manifest and latent attributes disappears, it becomes possible to treat all numerical outputs as though they possess equivalent measurement properties. Utility scores, composite indices, preference weights, symptom scales, and observational counts can then be incorporated into the same analytical framework despite representing fundamentally different forms of information. The result is a loss of measurement discipline. Numerical constructions are accepted because they generate numbers rather than because they satisfy the requirements for measurement.

The implications for HTA are substantial. Assessments combine manifest and latent outcomes within the same evaluative framework. Clinical events, resource utilization, patient preferences, quality-of-life scores, and economic projections are brought together through utility algorithms and cost-effectiveness models. Yet if the measurement properties of these outcomes have not been established, the resulting quantitative claims lack a defensible scientific foundation. The problem is not the use of multiple outcomes. The problem is the failure to recognize that different outcomes require different measurement approaches.

The absence of the manifest-latent distinction also helps explain the near absence of Rasch measurement within the HAS curriculum. If latent attributes are not explicitly identified as requiring a measurement model, then there is no perceived need to introduce the one framework capable of constructing a quantitative measure of latent attribute possession. Instead, ordinal responses are transformed into scores, utilities, or indices and subsequently treated as though measurement has already been achieved. The measurement problem is effectively bypassed.

From the perspective of curriculum design, this represents a classic example of curriculum inversion. Students are introduced to utility instruments, quality-of-life measures, patient-reported outcomes, and economic evaluation techniques without first being taught the distinction between manifest and latent attributes. Consequently, they are never encouraged to ask the critical question: what type of attribute is being assessed, and what form of measurement is required to support a quantitative claim regarding that attribute?

A scientifically defensible HTA curriculum would begin with precisely this question. Before discussing utilities, QALYs, preference weights, or simulation models, students would first identify the target attribute. They would determine whether it is manifest or latent. They would then establish the appropriate form of ratio measurement required for that attribute. Only after these steps had been completed would quantitative claims be considered.

The interrogation therefore suggests that HAS does not provide an explicit educational framework for distinguishing manifest from latent attributes or for understanding the central role of ratio measurement in therapy assessment. This omission is not a minor curricular gap. It removes one of the essential conceptual foundations required for measurement-based HTA. Until the distinction between manifest and latent attributes becomes a core element of HTA education, the discipline

will continue to treat fundamentally different forms of evidence as though they possess equivalent measurement status, perpetuating the broader pattern of measurement and curriculum inversion identified throughout the Canadian HTA knowledge base.

THE ABSENCE OF RASCH

One of the most striking findings from the interrogation of HAS is not simply the absence of representational measurement but the near-complete absence of Rasch measurement and its role in the assessment of latent attributes. This omission is important because it reveals a fundamental weakness in the educational and methodological framework that underpins contemporary health technology assessment. The issue is not whether the term "Rasch" appears occasionally in conference abstracts, research presentations, or specialist publications. The issue is whether Rasch measurement is recognized as the essential framework for constructing quantitative measures of latent attributes. The interrogation says that it is not.

This omission is particularly significant because HAS places considerable emphasis on patient-centered outcomes, quality of life, symptom burden, functional status, treatment satisfaction, patient experience, and similar constructs. These are all latent attributes. They cannot be directly observed in the same way that hospital admissions, survival time, medication possession, or adverse events can be observed. Latent attributes exist, but they are not directly measurable through counting, timing, or simple observation. Their measurement requires a formal measurement model.

This is where Rasch occupies a unique position. Rasch is not simply another psychometric technique competing with item response theory, PROMIS, utility instruments, or preference-based scoring systems. Rasch addresses a fundamentally different question. It asks whether ordinal observations can be transformed into a quantitative measure of possession of a latent attribute. In doing so, it provides the only established framework capable of demonstrating whether the conditions required for measurement have been satisfied.

The distinction is critical. Patient-reported outcomes typically begin with ordinal responses to questionnaire items. Patients may indicate levels of pain, fatigue, anxiety, mobility limitations, or functional difficulties. These responses are rankings. They provide information about order but not quantity. Arithmetic performed directly on ordinal observations cannot create measurement. Summing scores, averaging responses, applying weights, or generating utility algorithms does not transform ordinal observations into quantitative measures. Numerical manipulation is not measurement.

The Rasch model was developed in the 1950s precisely to address this problem. Through the conjoint calibration of persons and items, Rasch analysis estimates the location of respondents on a latent continuum while simultaneously testing whether the data satisfy the requirements for measurement. Unidimensionality, invariance, item fit, category functioning, local independence, and differential item functioning are not optional refinements. They are the conditions that must be satisfied before claims regarding possession of a latent attribute can be advanced. Rasch therefore provides both a measurement model and a set of empirical tests for determining whether measurement is possible.

The interrogation suggests that this perspective is absent from the HAS educational framework. Students and practitioners are introduced to patient-reported outcomes, utility instruments, preference weights, quality-of-life measures, and value assessment methodologies without first confronting the measurement problem those constructs are intended to address. The curriculum appears to move directly from patient responses to scoring systems and economic evaluation. The intermediate step, demonstrating that a latent attribute has been measured, is effectively bypassed.

This omission has important consequences. Without Rasch measurement, latent attributes remain latent. Utility scores, composite indices, and preference-weighted algorithms may generate numerical outputs, but they do not establish that the underlying construct has been measured. The existence of a number should not be confused with the existence of a measure. Yet much of contemporary HTA proceeds as though this distinction does not matter.

The result is that students are trained to accept numerical representations of quality of life, patient benefit, symptom burden, and treatment impact without being introduced to the framework required to determine whether those representations possess measurement properties. They learn how utilities are generated, how QALYs are constructed, and how economic models are populated, but they are not taught how latent attributes can be measured. The educational sequence is therefore inverted. Numerical outputs are presented before the conditions required to justify those outputs.

The absence of Rasch is consequently more than a methodological omission. It is a defining characteristic of curriculum inversion. The curriculum recognizes the importance of latent attributes but fails to recognize the only framework capable of transforming observations of those attributes into quantitative measures. This leaves students and practitioners with a vocabulary of scores, utilities, and indices but without an understanding of measurement itself. Until Rasch measurement assumes its proper place within HTA education, latent attributes will continue to be represented through numerical constructions rather than lawful measures, and the distinction between scoring and measurement will remain obscured.

CONCLUSION: CURRICULUM INVERSION AND THE FUTURE OF HTA IN FRANCE

The companion interrogation of the HAS methodological knowledge base demonstrated that contemporary French health technology assessment is characterized by measurement inversion. Fundamental concepts drawn from representational measurement receive little recognition, while utilities, QALYs, cost-effectiveness ratios, and reference-case modelling are accepted as though they provide scientifically valid quantitative measures of therapy impact. The present study addresses the complementary question of how such a framework has become established and sustained. The answer is curriculum inversion.

The interrogation of the HAS curriculum knowledge base demonstrates that future HTA practitioners are introduced to the analytical methods of contemporary HTA before they are introduced to the scientific principles required to evaluate those methods. The educational emphasis is placed upon comparative effectiveness, utilities, economic evaluation, cost-effectiveness analysis, and modelling rather than upon the specification of attributes, the principal scales of measurement, representational measurement, admissible arithmetic, unidimensionality,

the distinction between manifest and latent attributes, Rasch measurement, and the requirement that quantitative claims be prospectively evaluable, replicable, and capable of falsification. Graduates therefore acquire competence in applying established HTA methods without first acquiring the scientific framework necessary to determine whether those methods can support lawful quantitative claims.

This finding explains the remarkable stability of the present HTA paradigm. Measurement inversion does not persist because its scientific foundations have been repeatedly examined and confirmed. Rather, it persists because the educational framework provides few opportunities for practitioners to encounter the principles upon which such an evaluation could be based. Successive generations of researchers, consultants, committee members, manufacturers, and policy analysts inherit an analytical framework whose measurement assumptions remain largely invisible. The result is a self-reinforcing intellectual system in which accepted methods are reproduced rather than critically examined.

This puts HAS in a position of considerable responsibility. As France's national HTA authority, its influence extends well beyond reimbursement decisions. Through its methodological guidance, educational resources, submission requirements, technical documentation, and professional expectations, HAS effectively defines the conceptual framework within which French HTA is taught and practiced. If that framework embodies both measurement inversion and curriculum inversion, these become institutional characteristics of the French HTA system rather than isolated methodological preferences.

The implications are profound. The challenge facing HAS is no longer one of refining economic models, improving evidence synthesis, expanding real-world evidence, or modifying reference-case assumptions. These initiatives leave untouched the more fundamental question of whether the quantities entering HTA analyses satisfy the conditions required for quantitative measurement. Unless measurement precedes arithmetic, methodological sophistication cannot compensate for the absence of valid measurement. More complex models merely generate more elaborate calculations based upon quantities whose scientific status remains unresolved.

The future of HTA in France therefore depends upon breaking the cycle through which curriculum inversion perpetuates measurement inversion. Reconstruction must begin by restoring representational measurement to its proper position as the scientific foundation of HTA education and practice. Students, researchers, manufacturers, consultants, committee members, and decision makers should first understand the nature of attributes, the requirements for lawful measurement, the distinction between manifest and latent variables, linear ratio and Rasch logit ratio measurement, dimensional homogeneity, admissible arithmetic, and the necessity for evaluable and falsifiable claims. Only then should the analytical techniques of HTA be introduced.

The choice facing HAS is therefore clear. It can continue to educate practitioners within a framework that assumes the validity of utilities, QALYs, and conventional economic evaluation without first establishing their measurement foundations, or it can lead the transition toward a genuinely scientific model of HTA grounded in representational measurement. The companion paper demonstrated why the existing analytical framework fails the requirements of measurement science. The present study demonstrates why that framework has remained largely unchallenged.

Together they indicate that the future of HTA in France depends not upon incremental methodological refinement but upon replacing curriculum inversion with an educational framework in which measurement once again precedes arithmetic. Only then can French HTA claim to satisfy the standards expected of a quantitative scientific discipline.

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