

# MEASUREMENT-BASED HEALTH TECHNOLOGY ASSESSMENT: FOUNDATIONS PROGRAM

## INTRODUCTION

Over the past year a series of structured interrogations of the global health technology assessment (HTA) literature has been undertaken using a standardized 24-item diagnostic instrument grounded in the axioms of representational measurement theory. Using large language models to interrogate the published knowledge bases of more than one hundred HTA jurisdictions, agencies, journals, academic centers, and professional organizations, each assessment produced categorical endorsement probabilities and normalized logit profiles indicating whether the fundamental principles of measurement were recognized within those knowledge systems.

The results are strikingly consistent. Across countries, agencies, journals, and academic programs, the logit profiles reveal a systematic absence of key measurement concepts. Principles that are elementary within measurement science such as unidimensionality, dimensional homogeneity, invariance, and the requirement that measurement precede arithmetic are rarely articulated and almost never operationalized in HTA practice. Constructs such as utility scores, composite patient-reported outcome scales, QALYs, and cost-effectiveness ratios are routinely treated as if they were quantitative measures, yet their scale properties are not demonstrated. In effect, arithmetic operations are applied to numerical scores that do not satisfy the axioms required for measurement.

The implication is not simply methodological disagreement but a structural problem in the way therapy impact is evaluated. When the attributes being analyzed have not been established as measurable quantities, the resulting numerical outputs cannot support empirically evaluable or falsifiable claims regarding therapy performance. Instead of measuring therapy response, current HTA frameworks often generate numerical summaries whose apparent precision masks the absence of lawful measurement foundations.

The **Measurement-Based HTA: Foundations Program** has been developed in response to these findings. Its purpose is to provide researchers, analysts, and faculty with the conceptual and methodological tools necessary to correct these measurement errors and reconstruct therapy evaluation on a scientifically valid basis. The program introduces the principles of representational measurement, explains the scale structures required for quantitative analysis, and demonstrates how therapy impact can be evaluated through lawful measurement systems.

Two measurement structures form the basis of this framework. Manifest attributes—such as survival time, hospital utilization, or other observable clinical outcomes—must be measured on linear ratio scales possessing a true zero and invariant units. Latent attributes—such as pain severity, functional limitation, or quality of life—require transformation through Rasch measurement, which constructs invariant logit ratio scales from subjective observations.

By establishing these foundations, the program provides a pathway for moving HTA from numerical storytelling toward genuine measurement of therapy response. It is intended as the

first step in building a measurement-literate HTA community capable of developing empirically evaluable claims regarding the real impact of medical therapies.

## **FOUNDATIONS PROGRAM OVERVIEW**

### **PROGRAM DIRECTOR**

#### **Dr. Paul C. Langley, PhD**

Adjunct Professor, College of Pharmacy, University of Minnesota, Minneapolis MN and Director, Maimon Research LLC, Tucson AZ

Dr. Paul C. Langley is an economist trained in the United Kingdom and Canada with over four decades of experience in health economics and health technology assessment. He has held academic appointments in the UK, Canada, the United States, and Australia and currently serves as Adjunct Professor at the College of Pharmacy, University of Minnesota.

He has authored more than 100 peer-reviewed publications and has held senior industry leadership roles, including Global Head of Health Economics at 3M Pharmaceuticals. His recent work focuses on representational measurement theory and Rasch measurement as foundations for therapy impact claims. He has conducted structured interrogation of over 100 international HTA knowledge bases using canonical measurement diagnostics, forming the empirical basis for this program.

### **WHY THIS PROGRAM IS NECESSARY**

For more than forty years, HTA education has focused on modelling techniques, incremental ratio calculation, and composite outcome aggregation. Students are trained to manipulate models and interpret outputs without systematic exposure to the formal conditions under which those operations are mathematically defensible.

As scrutiny increases regarding evaluability, falsifiability, and scale validity, departments must ensure that graduates understand not only how to calculate, but when calculation is lawful.

At present, there is no comprehensive textbook that integrates representational measurement theory, Rasch transformation, and therapy evaluation within a unified HTA framework. Faculty wishing to teach measurement foundations must assemble materials from disparate disciplines.

This program fills that gap.

Participants receive extensive structured technical notes developed specifically for this course. These materials function as a textbook substitute and form a core component of the program's value. They synthesize scale theory, Rasch measurement, dimensional analysis, and HTA application into a coherent instructional architecture. Institutions therefore acquire not only training, but durable teaching infrastructure.

## **PROGRAM OBJECTIVES**

The program is designed to achieve four complementary objectives.

### **Conceptual Clarity**

Participants will understand the axioms of representational measurement theory and the constraints those axioms impose on quantitative reasoning. They will distinguish clearly between scores and measures, ordinal rankings and ratio quantities, and simulation outputs and empirically evaluable claims.

### **Technical Competence**

Participants will distinguish manifest attributes from latent constructs and understand how Rasch transformation produces invariant logit ratio measures suitable for latent trait evaluation.

### **Constructive Capability**

Participants will learn to design therapy impact claims that satisfy measurement constraints and avoid dimensional incoherence.

### **Institutional Readiness**

Participants will be in a position to prepare a 3-unit graduate course framework enabling immediate curriculum integration.

## **THE FOUR-UNIT PROGRAM STRUCTURE**

The program comprises 4 units. Each has extensive notes, key questions and answers and references

### **Unit One: Measurement Before Arithmetic**

This unit establishes the logical foundations of quantitative reasoning. Scale types are examined operationally. Participants analyze why arithmetic operations are constrained by scale properties and evaluate common HTA constructs against these constraints. Dimensional homogeneity and the requirement of ratio properties are treated rigorously. By the end of this week, participants possess a precise understanding of lawful quantitative representation.

### **Unit Two: Manifest and Latent Attributes**

Participants examine the structural distinction between directly observable attributes and latent traits. Manifest attributes such as survival time may be represented on linear ratio scales. Latent constructs such as pain severity require transformation. The Rasch framework is introduced as a conjoint simultaneous measurement model capable of producing invariant logit ratio scales. Emphasis is placed on measurement logic rather than statistical technique.

### **Unit Three: Reconstructing Therapy Impact Claims**

This unit transitions from diagnosis to construction. Participants learn to formulate therapy impact claims consistent with representational measurement constraints. Manifest and latent claims are structured separately. Composite collapse is avoided. Protocol-based evaluation strategies are introduced.

## **Unit Four: Institutional Transition and Curriculum Implementation**

The final unit focuses on integration. Participants examine strategies for redesigning HTA modules, supervising graduate research within measurement constraints, and implementing the integrated 3-unit course framework.

## **WHO SHOULD TAKE THE PROGRAM**

This program is designed for:

- Faculty teaching HTA, pharmacoeconomics, or outcomes research
- Graduate program directors seeking curriculum modernization
- Doctoral supervisors guiding quantitative evaluation research
- Senior analysts overseeing methodological standards
- Regulatory or reimbursement professionals seeking deeper measurement foundations

## **INSTITUTIONAL VALUE**

Measurement-Based HTA strengthens academic credibility, enhances graduate training, and positions departments at the forefront of evolving methodological standards. As scrutiny of quantitative claims increases, institutions that proactively engage with measurement foundations will distinguish themselves academically and professionally.

The investment of US\$375.00 represents a modest cost relative to the long-term benefit of curriculum modernization and defensible quantitative training.

## **WHAT PARTICIPANTS WILL BE ABLE TO DO AFTER THE PROGRAM**

Participants completing the Foundations Program will possess a structured understanding of the measurement principles required for scientifically valid evaluation of therapy impact. More importantly, they will be able to apply these principles directly in research, teaching, and policy analysis.

First, participants will be able to distinguish clearly between scores, indices, and genuine measures. They will understand the scale properties required for arithmetic operations and will be able to evaluate whether commonly used HTA constructs satisfy the axioms of representational measurement. This provides the ability to critically assess widely used frameworks such as utility scores, QALYs, and composite patient-reported outcome indices.

Second, participants will be able to identify and classify attributes correctly as manifest or latent. This distinction is essential for determining the appropriate measurement structure for therapy

evaluation. Manifest attributes such as survival time, hospital admissions, or other observable outcomes must be represented on linear ratio scales. Latent attributes such as pain severity or functional limitation require transformation through Rasch measurement to produce invariant logit ratio scales.

Third, participants will be able to design therapy impact claims that conform to measurement constraints. They will learn how to structure claims around measurable attributes, avoid composite collapse, and develop protocols capable of supporting credible, evaluable, and replicable evidence. This capability allows researchers and analysts to move beyond numerical summaries and toward empirically testable statements about therapy performance.

Fourth, participants will acquire the conceptual tools needed to interpret Rasch measurement frameworks and latent trait instruments. While the program emphasizes measurement logic rather than advanced statistical technique, participants will understand how Rasch models transform ordinal observations into measurement scales and why this transformation is essential for evaluating patient-reported outcomes.

Finally, participants will be equipped to integrate measurement-based HTA principles into academic teaching and research supervision. The program provides a framework for redesigning HTA modules, guiding graduate research, and developing measurement-valid evaluation strategies within health systems and policy environments.

Taken together, these capabilities enable participants to move from passive users of conventional HTA methods to informed practitioners capable of reconstructing therapy evaluation on measurement-valid foundations.