



Proficiency Testing Programmes by Health Sciences Authority Singapore, with assigned values determined by a reference method

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Outline

- Overview of HSA Chemical Metrology Laboratory
- Overview of HSA Chemical Metrology Laboratory's PT/EQA Programmes
- Benefits of Participating in a PT Programme – deriving the assigned value from a reference method
- Performance of the Participating Laboratories

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About the HSA Chemical Metrology Laboratory



HSA is a Designated Institute responsible for developing the chemical metrology programme to enhance the accuracy of chemical measurements in Singapore. Our areas of focus are **healthcare, food, pharmaceuticals & health products**.



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The HSA Chemical Metrology Laboratory



➤ Quality system

- The quality system is based on **ISO/IEC 17025, ISO/IEC 17043 and ISO Guide 34 (new ISO 17034)**.
- ISO/IEC 17025 & ISO Guide 34 - The Lab was assessed by Singapore Accreditation Council (SAC) and peer reviewed by a team of experts from the international chemical metrology community.
- ISO/IEC 17043 - The Lab is accredited by SAC as a PT Provider since August 2013.

➤ Chemical metrology activities

- Since 2008, the laboratory participates actively in regional & international chemical metrology activities, including over 40 relevant regional & international comparisons.
- HSA is a full member of the Asia Pacific Metrology Programme (APMP) since 2008.
- HSA is also a member of the Consultative Committee for Amount of Substance: Metrology in Chemistry and Biology (CCQM).

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The HSA Chemical Metrology Laboratory



➤ Laboratory facilities

- The laboratory is housed in a cleanroom with a rating of ISO Class 7.
- A special “metal free” section was created in the laboratory for inorganic analysis.
- The laboratory has a wide array of instruments to support its measurement activities.



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HSA's PT/EQA Programmes

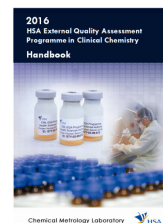
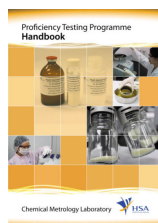


In the HSA PT/EQA programmes, the assigned values are independently determined by Chemical Metrology Laboratory (CML) and are **traceable to the International System of Units (SI)**.

Each assigned value has an associated measurement uncertainty, estimated after rigorous investigation of all possible sources of uncertainties^{1,2}.

Objective

Enables participating labs to assess the **COMPARABILITY** and **ACCURACY** of their test results



¹ ISO/IEC Guide 98-3:2008 Uncertainty of Measurement – Part 3: Guide to the Expression of Uncertainty in Measurement (GUM:1995)
² Eurachem Guide on Quantifying Uncertainty in Analytical Measurement

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HSA PT Programmes For Chemical Testing Labs (2011-2017)



Additives in Food

- Benzoic acid in orange juice (2011)
- Benzoic acid, methyl paraben & n-butyl paraben in soy sauce (2013)
- Saccharin & sodium cyclamate in fruit juice (2015)
- Acesulfame potassium & sucralose in cake mix flour (2016) – APLAC PT Co-organised with SAC
- Preservatives in food sauce (2018)

Elements in Food/Beverage

- Arsenic, calcium, cadmium & lead in mushroom powder (2012)
- Lead in alcoholic beverage (2014)
- Toxic and Essential Elements in brown rice flour (2017)

Elements in Water

- Calcium, cadmium, lead & nickel in drinking water (2011)
- Arsenic, chromium, copper and molybdenum in drinking water (2014)
- Aluminium, calcium, cadmium, lead, nickel, arsenic, chromium, copper and molybdenum in drinking water (2016)

Elements in Cosmetics

- As, Pb & Hg in cosmetic cream (2015)
- Toxic elements in lipstick (2018)

Others

- Oil & grease in water (2016)
- Trihalomethanes in water (2017)

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Advantages of HSA's PT Programmes



- Survey and gap analysis are conducted regularly to establish the needs for testing laboratories and to ensure relevancy to local needs.
- To ensure comparability of results, in some of the PT programmes like preservatives in soy sauce and artificial sweeteners in fruit juice, high purity reference standards were also offered to the participating laboratories for use as calibration standards.
- Forum discussion sessions are organised at the end of the PT programmes to provide feedback and recommendations to improve the performance of the participating laboratories.



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**Underpinning Measurement Capabilities –
Participating in International Comparisons**



**Purity Assessment
of Organic
Compounds &
Peptides**

- 01 CCQM-K55.b: Characterisation of organic substances for chemical purity - aldrin
- 02 CCQM-K55.c: Characterisation of organic substances for chemical purity - L-valine
- 03 CCQM-K55.d: Characterisation of organic substances for chemical purity - folic acid

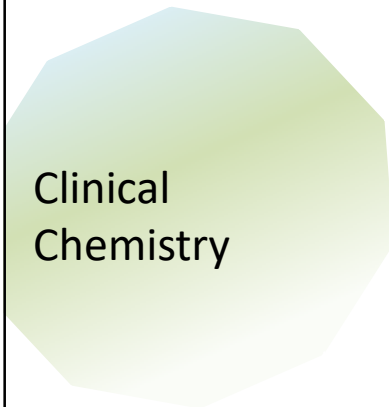
**Underpinning Measurement Capabilities –
Participating in International Comparisons**



**Additives,
Contaminants &
Elements in
Food/Water**

- 01 CCQM-K124: Trace elements in drinking water
- 02 APMP.QM-S8: Benzoic acid, methyl paraben and n-butyl paraben in soy sauce
- 03 CCQM-K108: Total arsenic and arsenic species in brown rice flour
- 04 CCQM-K95.1 Polycyclic aromatic hydrocarbon in tea

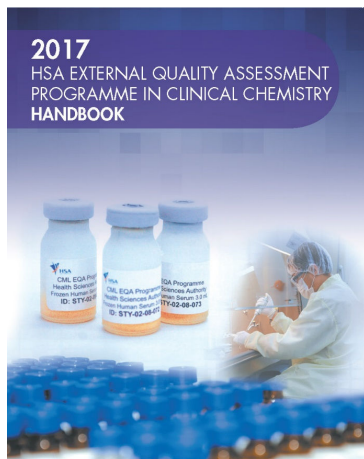
Underpinning Measurement Capabilities – Participating in International Comparisons



Clinical
Chemistry

- 01 CCQM-K107: Elements in human serum
- 02 CCQM-K6.2: Total cholesterol in human serum
- 03 CCQM-K12.2: Creatinine in human serum
- 04 CCQM-K109: Urea and uric acid in human serum

HSA EQA Programme for Clinical Labs



Chemical Metrology Laboratory



An **accuracy-based** EQA Programme (organised since 2011), where assigned values are independently determined by CML.

In human sera

- | | |
|--|---------------|
| 1. Creatinine | 7. Calcium |
| 2. Glucose | 8. Sodium |
| 3. Total cholesterol | 9. Potassium |
| 4. Triglycerides | 10. Magnesium |
| 5. Urea | 11. Iron |
| 6. Uric acid | 12. Chloride |
| 13. Low-density lipoprotein cholesterol (LDL) | |
| 14. High-density lipoprotein cholesterol (HDL) | |

In human blood

Glycated haemoglobin (HbA1c)

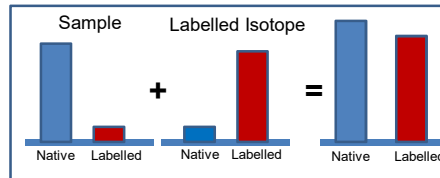
In urine

- | | |
|---------------|------------|
| 1. Creatinine | 2. Albumin |
|---------------|------------|

How are Assigned Values Determined by HSA CML?



In HSA CML, high accuracy gravimetric and/or isotope dilution mass spectrometric (IDMS) methods are used, whenever possible.



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Evaluation of Participating Laboratories' Results



$$z = \frac{x_i - x_{pt}}{\sigma_{pt}}$$

x_i is the participating laboratory's result
 x_{pt} is the assigned value determined by CML
 σ_{pt} is the standard deviation for proficiency assessment

$|z| \leq 2.0$ "satisfactory" result
 $2.0 < |z| < 3.0$ "questionable" result
 $|z| \geq 3.0$ "unsatisfactory" result

$$\zeta = \frac{x_i - x_{pt}}{\sqrt{u^2(x_i) + u^2(x_{pt})}}$$

x_i is the participating laboratory's result
 x_{pt} is the assigned value determined by CML
 $u(x_i)$ is the standard uncertainty reported by the participating laboratory
 $u(x_{pt})$ is the standard uncertainty of the assigned value x_{pt}

$|\zeta| \leq 2.0$ "satisfactory" result
 $2.0 < |\zeta| < 3.0$ "questionable" result
 $|\zeta| \geq 3.0$ "unsatisfactory" result

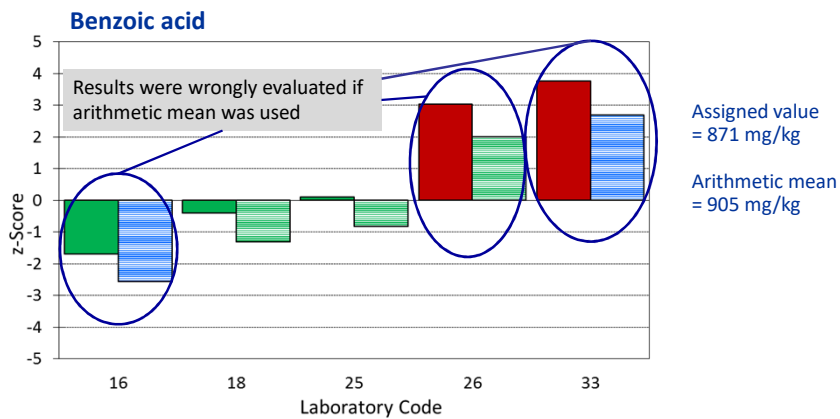
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Benefits of Participating in a PT Programme – deriving the assigned value from a reference method



STY-0026A Preservatives in Soy Sauce (2013)



z-Scores for benzoic acid evaluated by assigned values from CML (colour-filled columns) and robust means from participating laboratories' results (horizontal stripe columns).

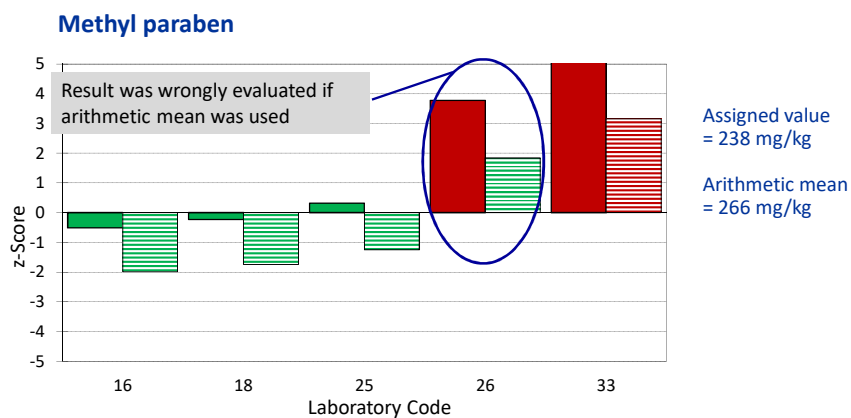
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Benefits of Participating in a PT Programme – deriving the assigned value from a reference method



STY-0026A Preservatives in Soy Sauce (2013)



z-Scores for methyl paraben evaluated by assigned values from CML (colour-filled columns) and robust means from participating laboratories' results (horizontal stripe columns).

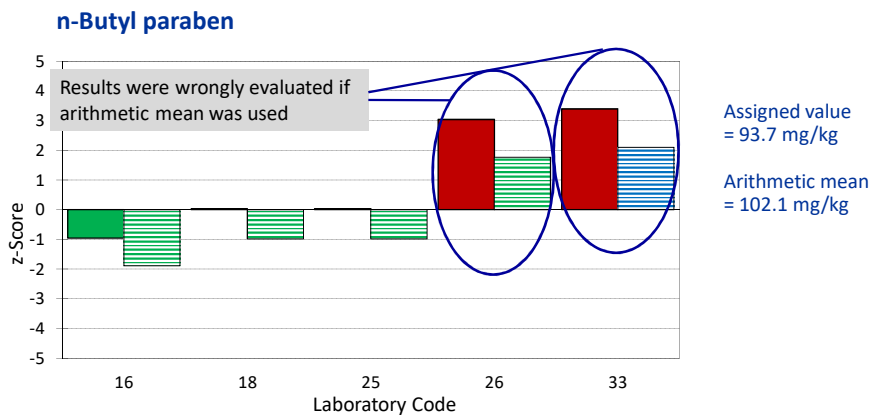
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Benefits of Participating in a PT Programme – deriving the assigned value from a reference method



STY-0026A Preservatives in Soy Sauce (2013)



z-Scores for n-butyl paraben evaluated by assigned values from CML (colour-filled columns) and robust means from participating laboratories' results (horizontal stripe columns).

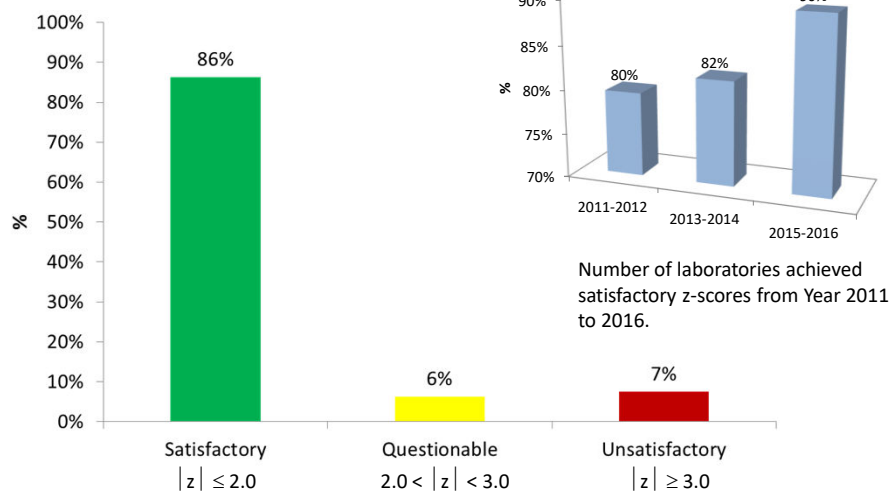
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Performance of the Participating Laboratories



Distribution of z-scores (2011-2016)



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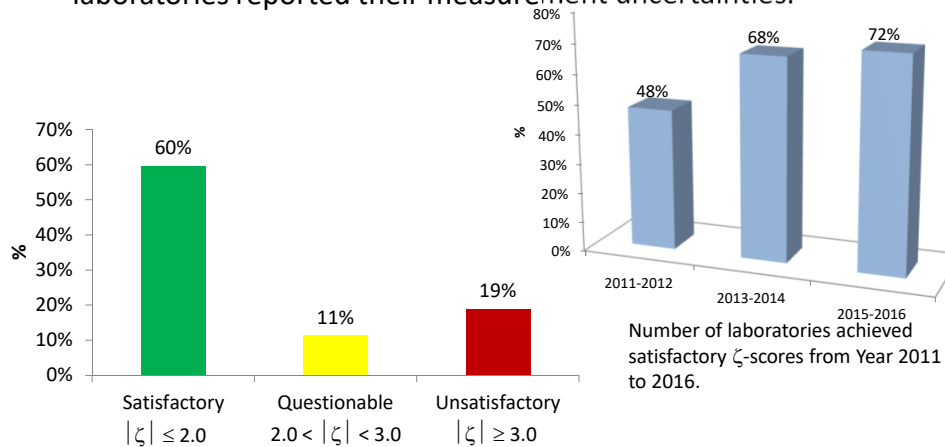
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Performance of the Participating Laboratories

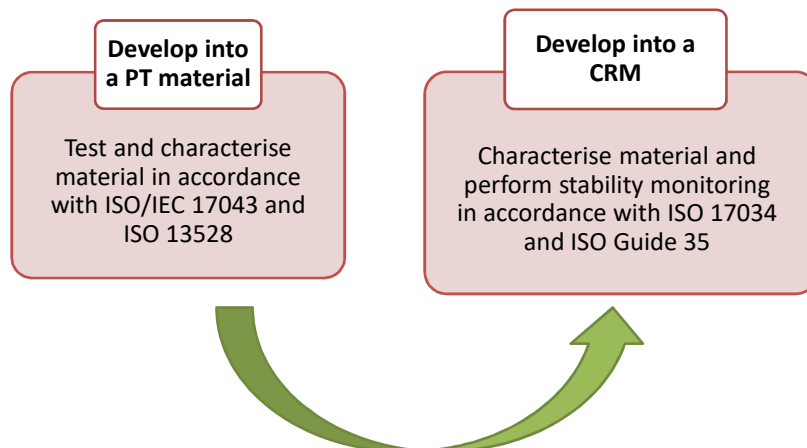


Distribution of ζ -scores (2011-2016)

- In the past PT Programmes, about 90% of the participating laboratories reported their measurement uncertainties.



CRMs for Continuous Monitoring of Quality of Testing



Our Certified Reference Materials



We Provide

- ✓ Pure substance CRMs as Calibrants
- ✓ Matrix CRMs for Quality Controls and Methods Validation

High Purity Substances

HRM-1002A	Benzoic Acid
HRM-1003A	Methyl Paraben
HRM-1004A	n-Butyl Paraben
HRM-1018A	Sorbic Acid
HRM-1006A	L-Valine
HRM-1007A	L-Proline
HRM-1008A	L-Leucine
HRM-1013A	L-Isoleucine
HRM-1014A	L-Phenylalanine
HRM-1009A	Sodium Cyclamate
HRM-1010A	Saccharin
HRM-1012A	Acesulfame Potassium
HRM-1015A	Sucralose
HRM-1019A	Aspartame
HRM-1016A	Carbamazepine

Clinical Chemistry

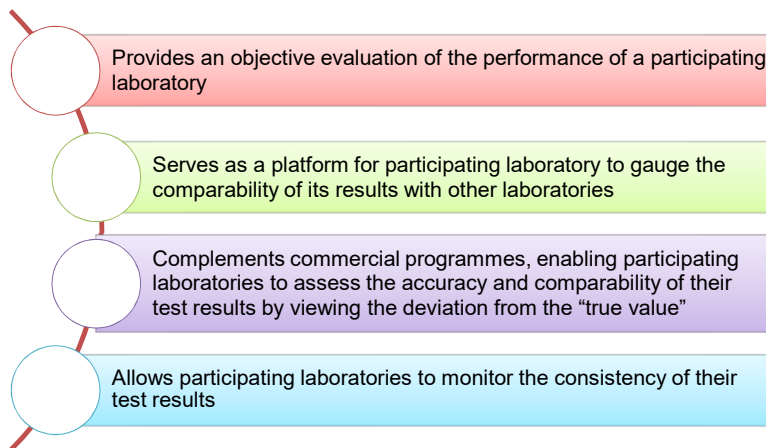
HRM-2002A	Ca, K & Na in Human Serum
HRM-2005A	Ca, K, Na, Mg, Fe & Cl in Human Serum
HRM-2011A	Na, Cl, Cu, Se & P in Human Serum
HRM-3002A	Creatinine, Glucose, Total Cholesterol, Total Glycerides, Urea & Uric Acid in Human Serum
HRM-3002B	Creatinine, glucose, total cholesterol, HDL-cholesterol, LDL-cholesterol, total glycerides, urea & uric acid in Human Serum
HRM-3003A	Glycated haemoglobin A1c (HbA1c) in Human Blood
HRM-3003B	Glycated haemoglobin A1c (HbA1c) in Human Blood

Food & Others

HRM-1005A	Benzoic Acid, Methyl Paraben & n-Butyl Paraben in Soy Sauce
HRM-2003A	As, Cd, Ca & Pb in Mushroom Powder
HRM-2006A	Pb, As & Hg in Cosmetic Cream
HRM-2008A	Cd, Pb, Total As and As species in apple juice
HRM-2009A	Al, As, Ca, Cd, Cr, Cu, Mo, Ni & Pb in water

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Values of HSA's PT Programmes



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Proficiency Testing / External Quality Assessment Programmes



For enquiries concerning PT programme: HSA_CMLPT@hsa.gov.sg

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Thank you

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