The international measurement system for ionizing radiation

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Part 1: Structures

…the opportunities to get involved at the international level

Two key international agreements

1875: Metre Convention

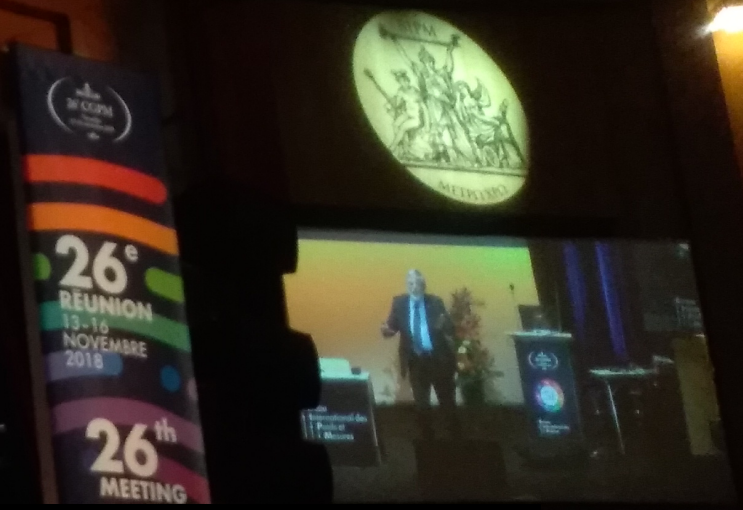
- Established the structures
- Set up a permanent secretariat – the BIPM
- By 2022: 64 Member States, 36 Associate States

1999: CIPM Mutual Recognition Arrangement

- Describes how States work together to harmonize measurements
- By 2022: 246 metrology institutes plus 4 international organizations

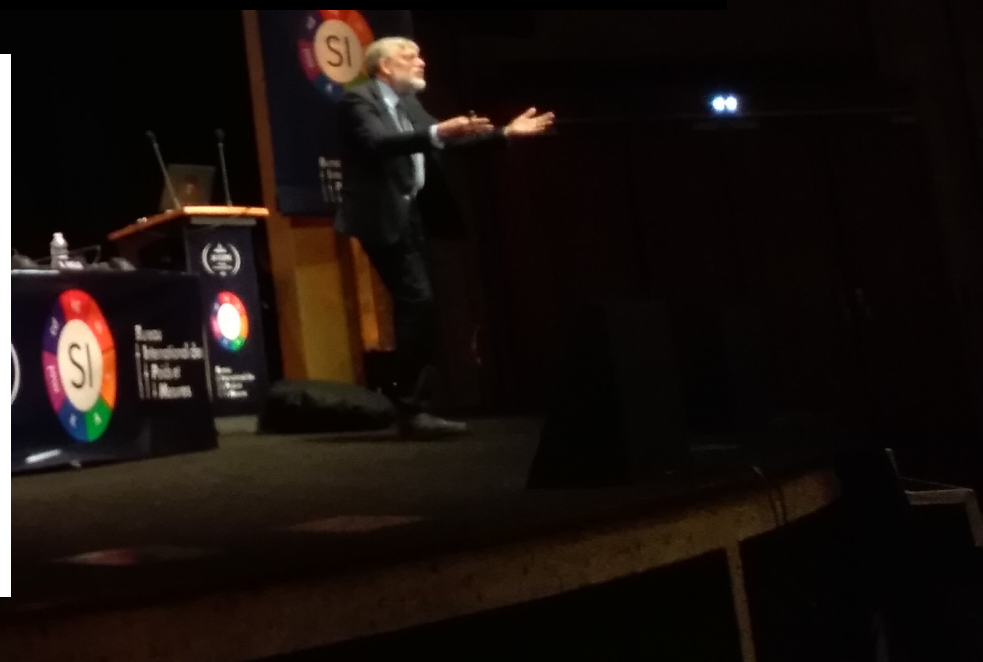
General Conference on Weights and Measures (CGPM)

- Decision-making body, meets every 4 years
- Attended by political and scientific representatives from Member States and Associate States
- Member States vote on resolutions
- Associate States are observers

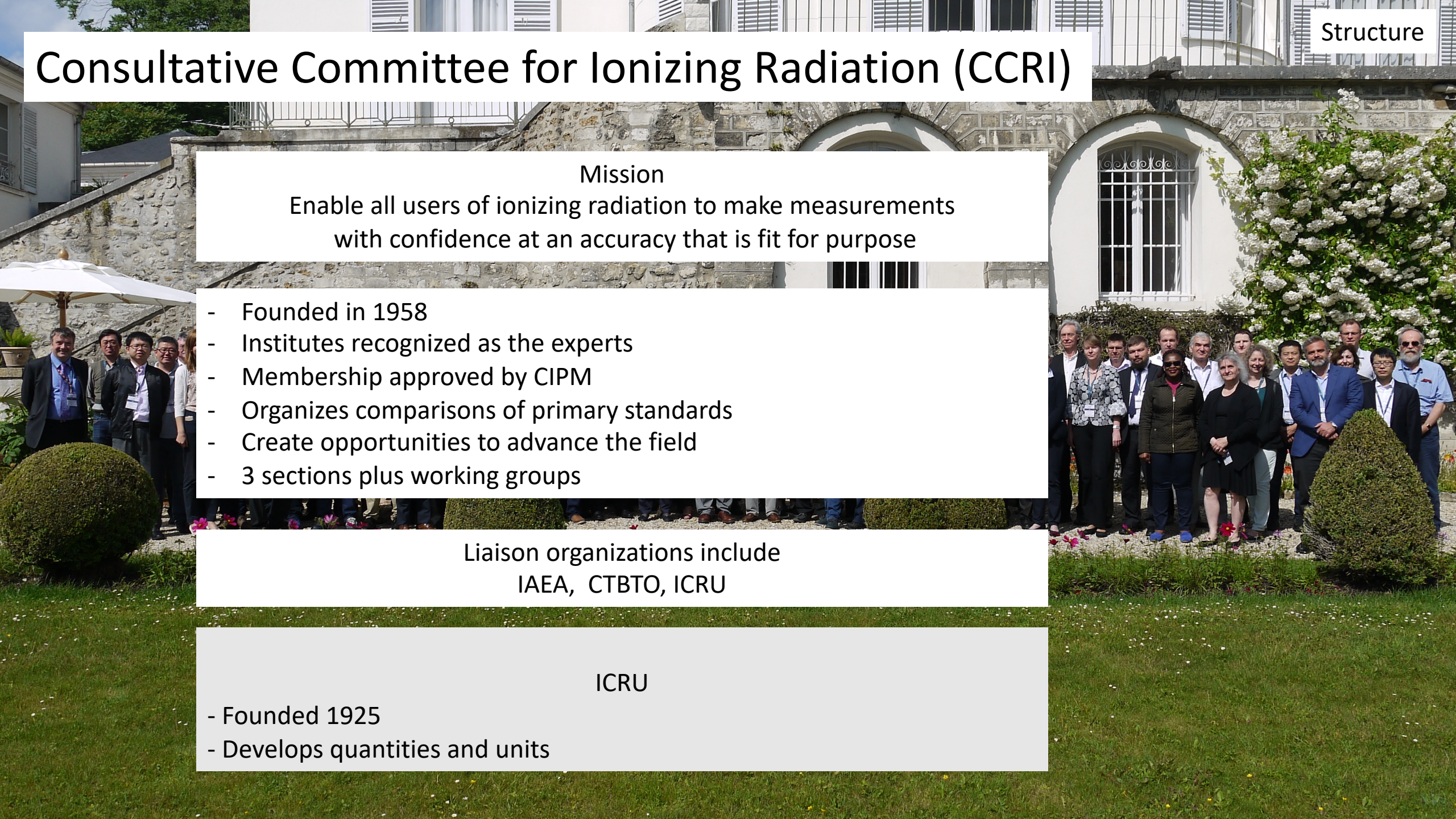


International Committee for Weights and Measures (CIPM)

- 18 members, elected by the CGPM
- Coordinates actions to promote world-wide uniformity of measurement
- Oversees the BIPM, including CBKT opportunities and secondments
- Advised by Consultative Committees



Consultative Committee for Ionizing Radiation (CCRI)



Mission

Enable all users of ionizing radiation to make measurements with confidence at an accuracy that is fit for purpose

- Founded in 1958
- Institutes recognized as the experts
- Membership approved by CIPM
- Organizes comparisons of primary standards
- Create opportunities to advance the field
- 3 sections plus working groups

Liaison organizations include
IAEA, CTBTO, ICRU

ICRU

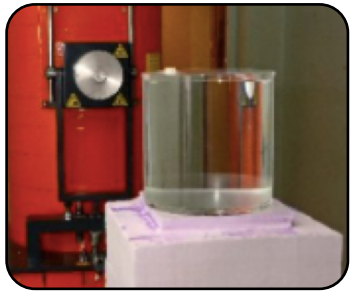
- Founded 1925
- Develops quantities and units

Regional Metrology Organizations (RMOs)

- Associations of metrology institutes
- Inclusive
- Engage with stakeholders and influence policy
- Share resources
- CBKT opportunities and regional projects

National Metrology Institutes (NMIs)

- One per Member or Associate State
- Appointed by government
- Holds national standards (primary or secondary)



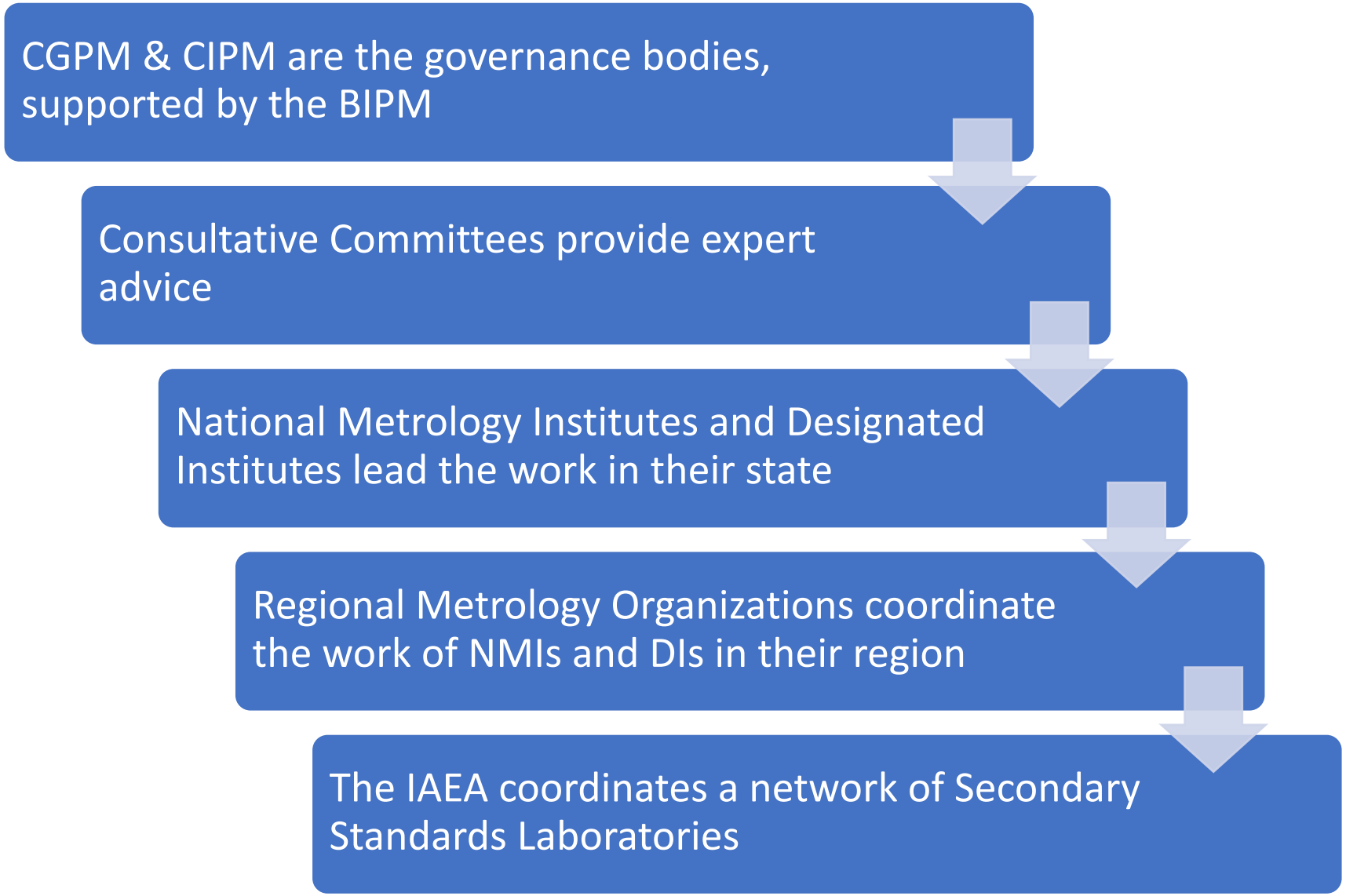
Designated Institutes (DIs)

- Holds national standards for a particular field
- One per field of measurement
- Appointed by NMI

Secondary Standard Dosimetry Laboratories

- Members of a separate network – the IAEA/WHO SSDL network
- May also be a DI or NMI

Summary of the structure



Part 2: How the global system works

…the CIPM Mutual Recognition Arrangement

Equivalence

Reconnaissance mutuelle

des étalons nationaux de mesure
et des certificats d'étalonnage et de mesurage
émis par les laboratoires nationaux de métrologie

Paris, le 14 octobre 1999

Supplément technique révisé en octobre 2003 (pages 17-20)

Mutual recognition

of national measurement standards
and of calibration and measurement certificates
issued by national metrology institutes

Paris, 14 October 1999

Technical Supplement revised in October 2003 (pages 38-41)

Comité international des poids et mesures

Bureau international des poids et mesures

Organisation intergouvernementale de la Convention du Mètre

- For a global system, national standards must be equivalent

- To show equivalence, NMIs and DIs must

  - Compare national standards

  - Have an ISO17025 quality system

  - Have their services peer-reviewed

- The outcome is an approved list of services (Calibration and Measurement Capabilities)

- To give confidence, results from comparisons are also published

- The BIPM maintains the database: the Key Comparison Database

Comparisons of national standards

What is compared?

- The principle techniques - key comparisons
- Other areas or techniques - supplementary comparisons

How are they run?

- Circulate
- Distribute
- One-to-one

Who arranges the comparisons?

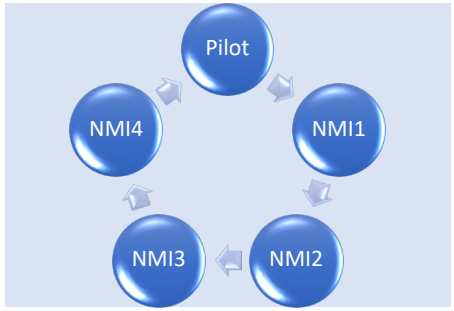
- CCRI
- RMO
- BIPM

Who can take part?

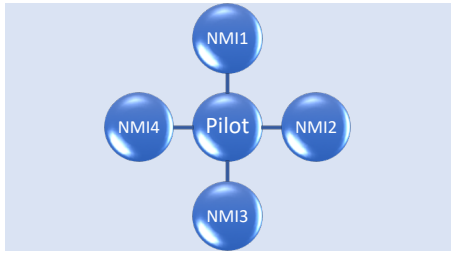
- Member States
- Associate States (case-by-case)

What is the value?

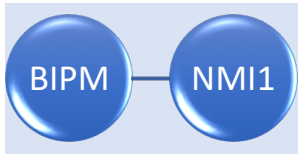
- Quantitative 'degree of equivalence'
- Contribute to international community
- An opportunity for knowledge transfer



Circulate instrument or artefact



Distribute dosimeters or sources



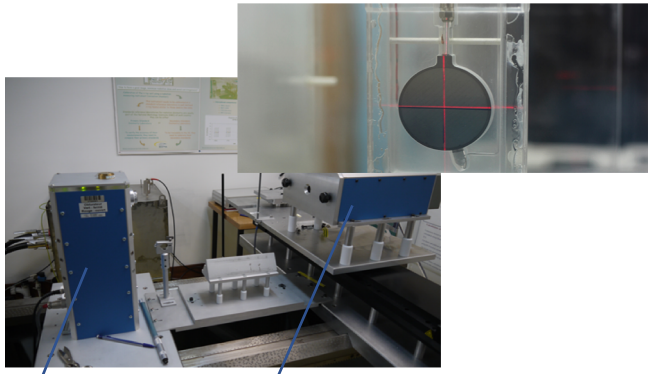
One-to-one – instrument or sources

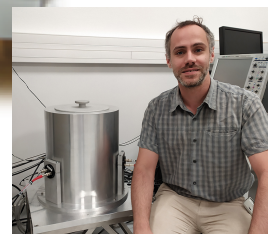
Two terms:

- Difference between the result and the (key) comparison reference value
- The uncertainty in the difference (95% level of confidence)

BIPM on-demand comparison services

- Free of charge to member states
- Dosimetry
  - Send or bring your national standard instrument to the BIPM
  - Compare to the BIPM standard, which sets the KCRV
- Radioactivity
  - Send a sample of a radioactivity standard to the BIPM (or arrange a site visit)
  - Compare your result to other NMIs/DIs using high-precision instruments





Typical result from comparison of national standards – air kerma, medium-energy x rays

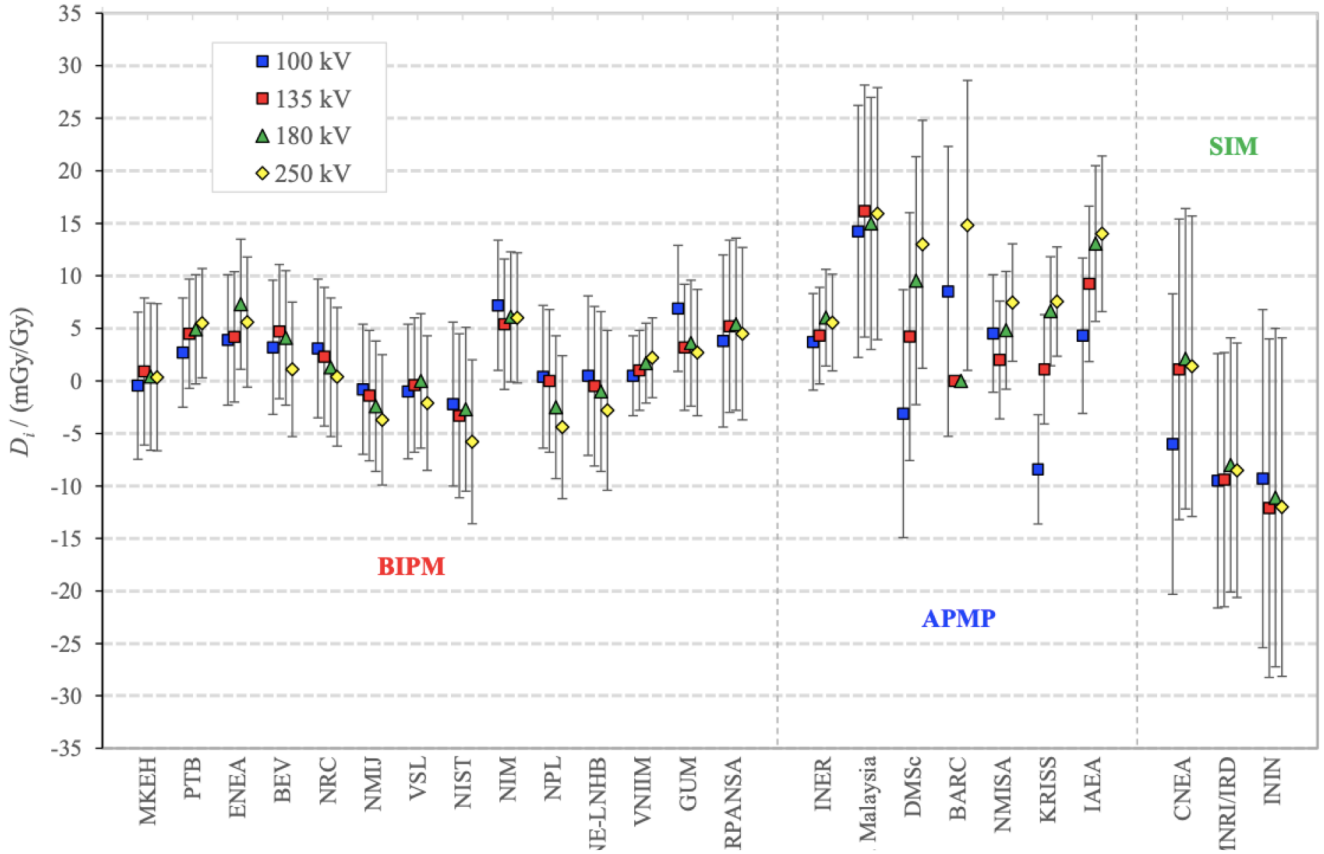
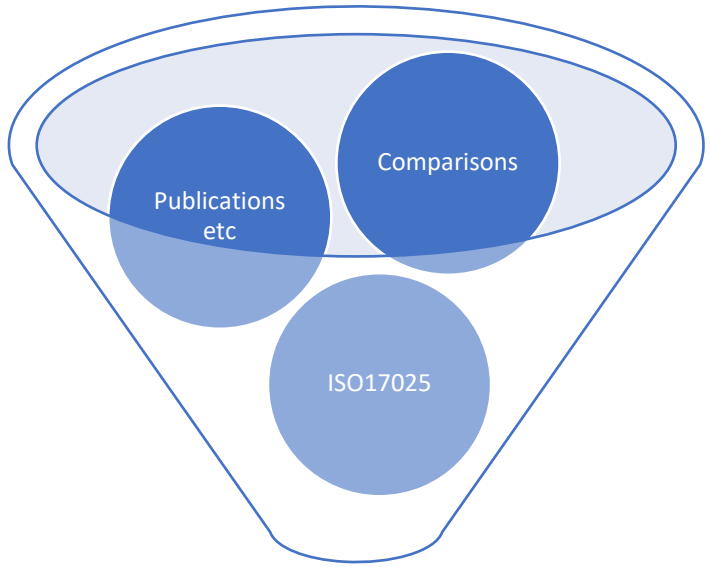


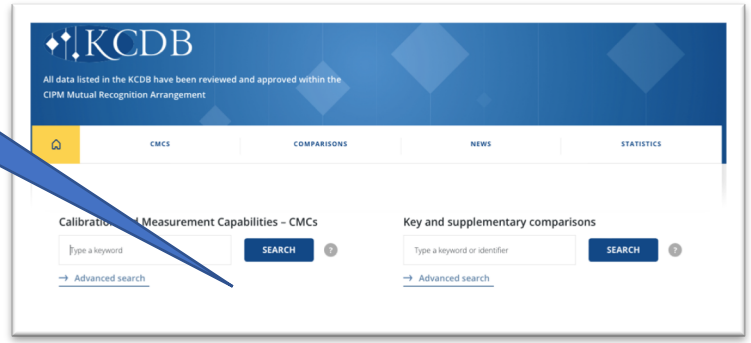
Figure 1. Degrees of equivalence for each laboratory *i* with respect to the key comparison reference value. Results to the left are for the ongoing international comparison BIPM.RI(I)-K3, those in the middle section are for the regional comparison APMP.RI(I)-K3 and those to the right are for the regional comparison SIM.RI(I)-K3.

Calibration and Measurement Capabilities (CMCs)

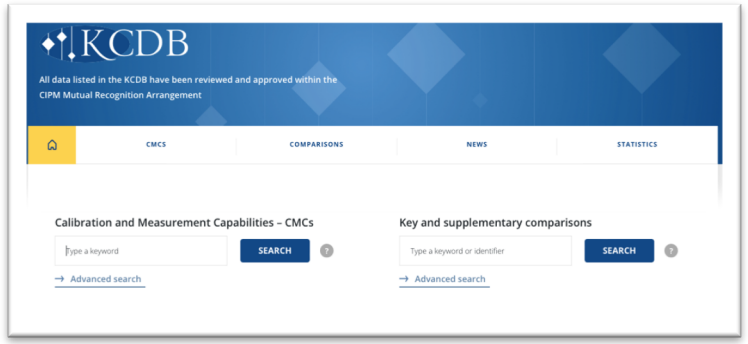


Published CMCs
Quantity
Uncertainty
Range
Method

Submit service to peer reviews
by RMOs



Traceability



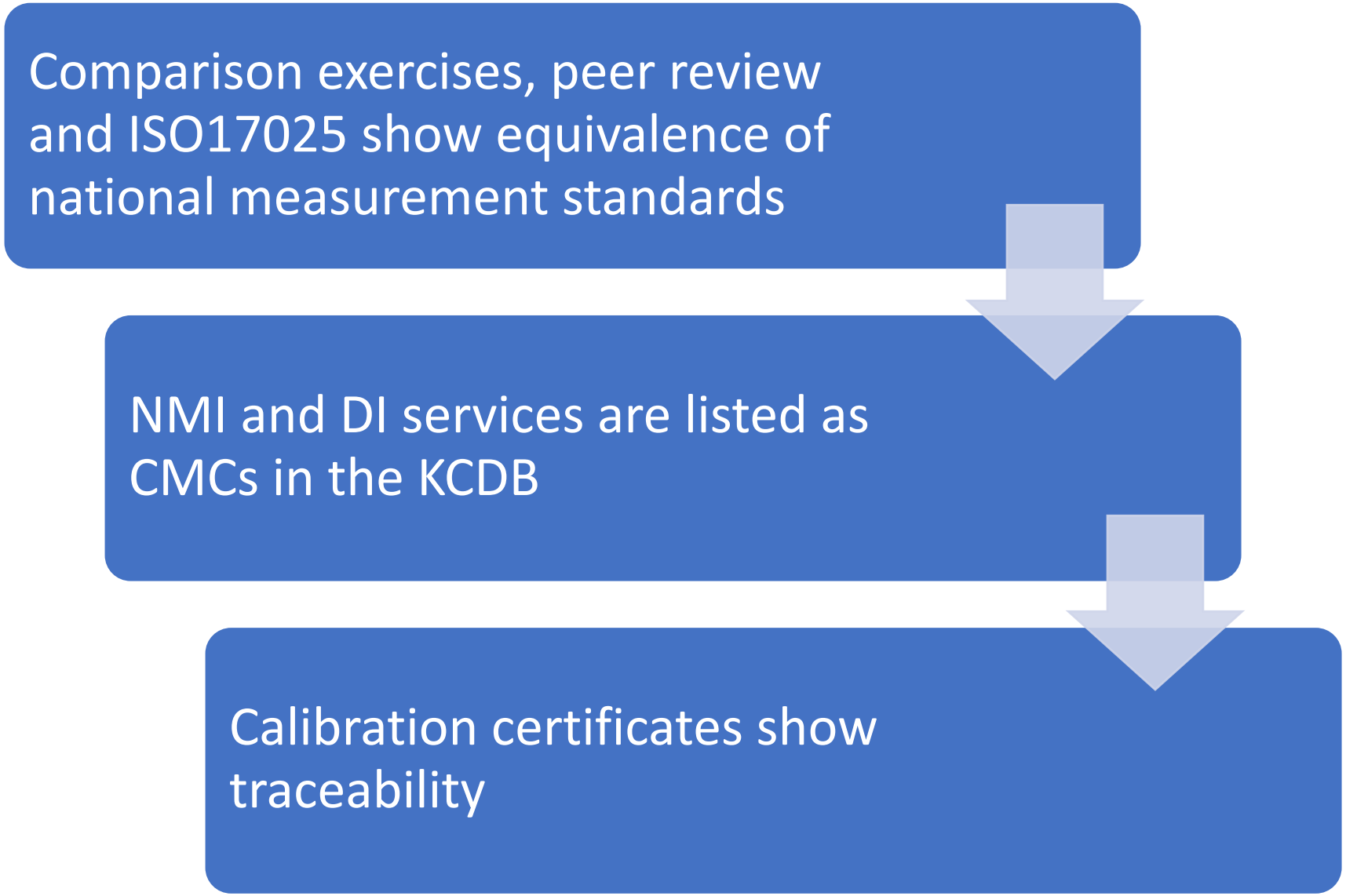
CMC: evidence that the service offered by the NMI or DI (or international organization) is linked to the international measurement system

Secondary standard laboratory

Tertiary laboratory / clinic / end user

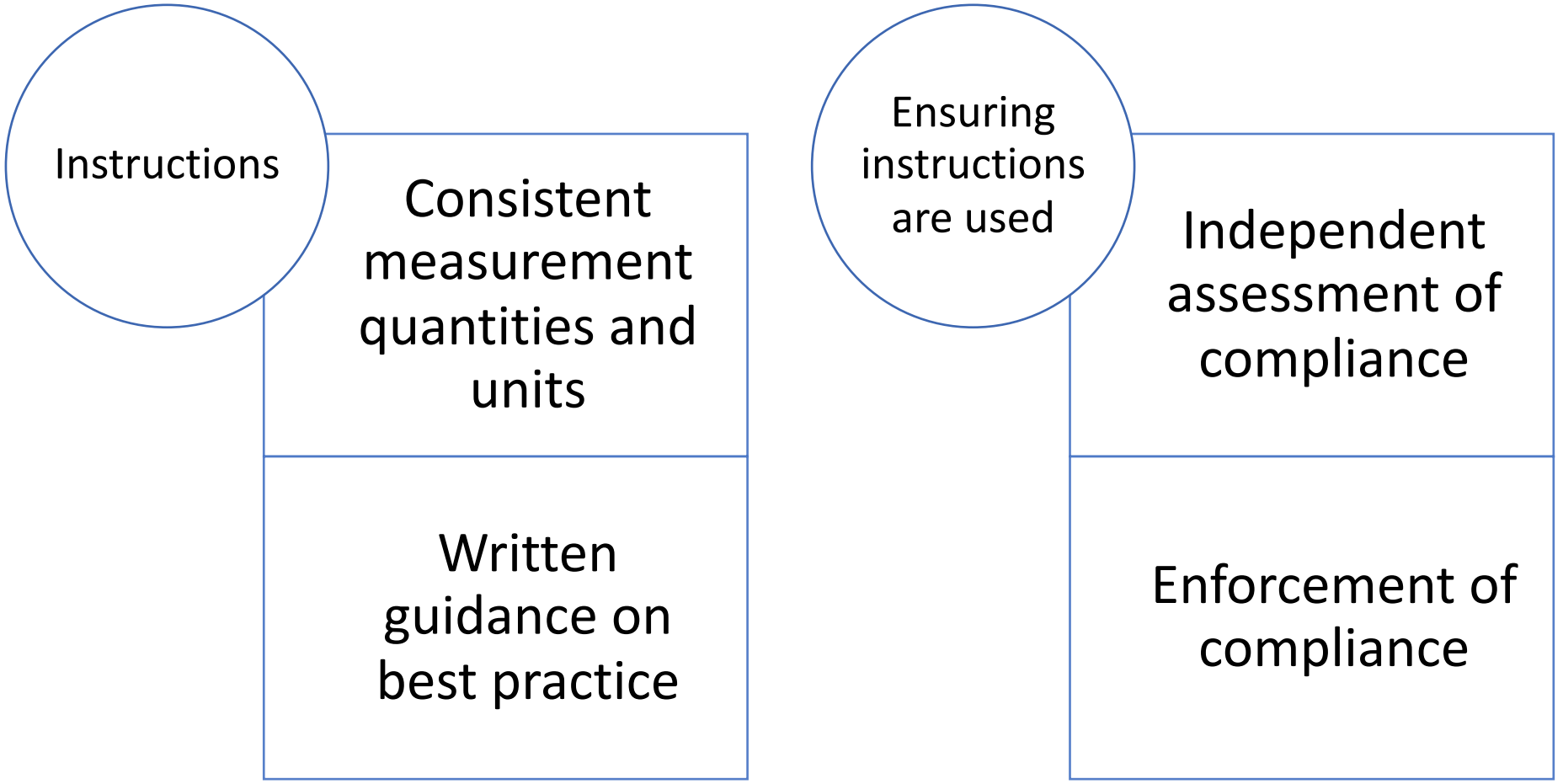
An unbroken chain of calibrations **with stated uncertainties**

Summary of how the system works



Part 3: The bigger picture

Quality infrastructure – the four elements



Quality infrastructure – the four elements

Instructions

Bureau International des Poids et Mesures

ISO

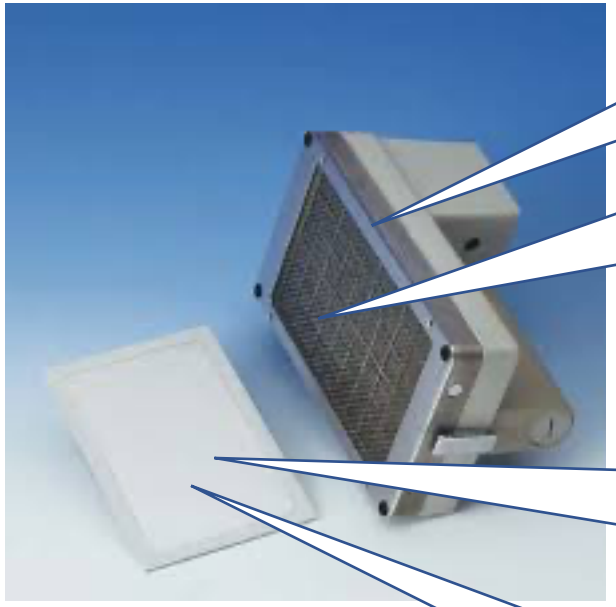
IAEA
International Atomic Energy Agency

Ensuring instructions are used

ilac

OIML

A simple example



Legal: ionizing radiations regulations say that the monitor must be calibrated once a year

Guidance: ISO7503 and the IAEA documents explain how to calibrate the instrument

Traceability: Reference sources are made and calibrated to ISO8769, and are traceable to Class 1 standards held by NMIs/DIs

Equivalence: NMIs compare their standards and publish their capabilities on the KCDB

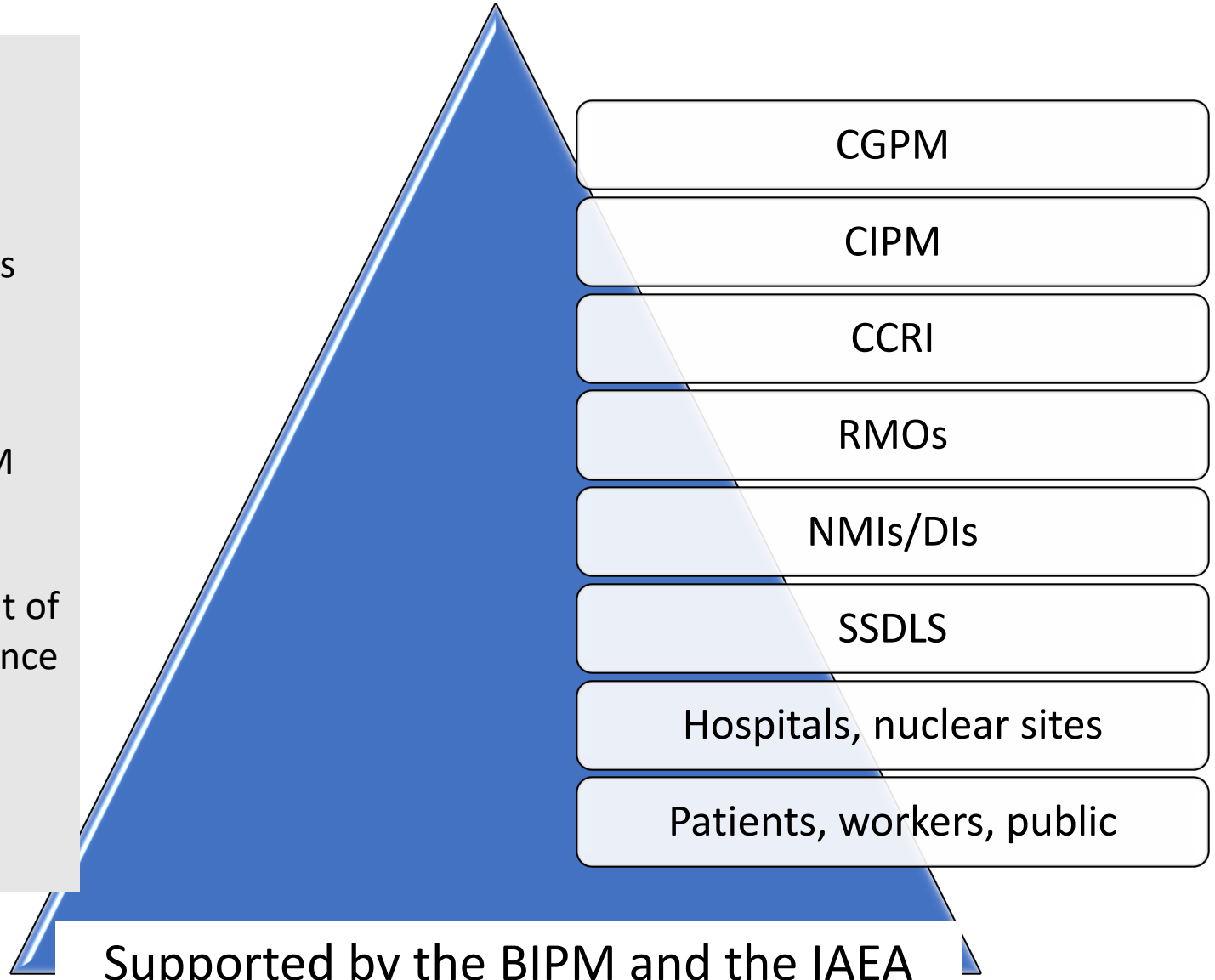
Organized by the CCRI or RMOs

Using quantities and units agreed by the CGPM

Summary

Opportunities to get involved

- Attend CBKT events
- Attend RMO meetings
- Contribute to research projects
- Participate in comparisons
- Champion your quality system
- Submit CMC claims
- Seek secondments to the BIPM
- If eligible, contribute to CCRI committees
- Contribute to the development of ISO standards and other guidance
- Audit other laboratories
- etc etc



Supported by the BIPM and the IAEA and all held together by a common quality standard – ISO17025

Thank you for listening