BIPM

Consultative Committee for Amount of Substance: Metrology in Chemistry and Biology (CCQM)

Report of the 30th meeting

(10-11 April 2025)

to the International Committee for Weights and Measures

CCQM

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LIST OF MEMBERS OF THE CONSULTATIVE COMMITTEE FOR AMOUNT OF SUBSTANCE: METROLOGY IN CHEMISTRY AND BIOLOGY

as of 10 April 2025

President

Dr S.-R. Park, member of the International Committee for Weights and Measures also Korea Research Institute of Standards and Science [KRISS], Daejeon.

Executive Secretary

Dr R. Wielgosz, International Bureau of Weights and Measures [BIPM], Sèvres.

Members

Centro Nacional de Metrología [CENAM], Querétaro.

D.I. Mendeleyev Institute for Metrology, Rosstandart [VNIIM], St Petersburg.

Danish Fundamental Metrology A/S [DFM], Hørsholm.

Federal Institute for Materials Research and Testing/Bundesanstalt für Materialforschung und –prüfung [BAM] Berlin.

Federal Institute of Metrology METAS [METAS], Bern-Wabern.

Health Sciences Authority [HSA], Singapore.

Instituto Nacional de Metrologia, Qualidade e Tecnologia [INMETRO], Rio de Janeiro.

Instituto Português da Qualidade [IPQ], Caparica.

Korea Research Institute of Standards and Science [KRISS], Daejeon.

LGC Ltd [LGC], Teddington.

Laboratoire National de Métrologie et d'Essais [LNE], Paris.

National Institute of Metrological Research/Istituto Nazionale di Ricerca Metrologica [INRIM], Turin.

National Institute of Metrology [NIM], Beijing.

National Institute of Metrology (Thailand) [NIMT], Pathumthani

National Institute of Standards and Technology [NIST], Gaithersburg.

National Measurement Institute, Australia [NMIA], Lindfield.

National Metrology Institute of Japan, AIST [NMIJ/AIST], Tsukuba.

National Metrology Institute of South Africa [NMISA], Pretoria.

National Metrology Institute of Türkiye /TÜBITAK Ulusal Metroloji Enstitüsü [UME], Gebze-Kocaeli.

National Physical Laboratory [NPL], Teddington.

National Research Council of Canada [NRC], Ottawa.

Physikalisch-Technische Bundesanstalt [PTB], Braunschweig.

RISE Research Institute of Sweden AB [RISE], Borås.

Slovak Institute of Metrology/Slovenský Metrologický Ústav [SMU], Bratislava.

VSL Dutch Metrology Institute [VSL], Delft.

The Director of the International Bureau of Weights and Measures [BIPM], Sèvres.

Observers

All-Russian Scientific Research Institute of Physical Technical Measurements, Rosstandart [VNIIFTRI], Moscow.

Bulgarian Institute of Metrology [BIM], Sofia.

Central Office of Measures [GUM], Warsaw.

Centro Español de Metrología [CEM], Madrid.

CSIR National Physical Laboratory of India [NPLI], New Delhi.

Government Laboratory [GL], Kowloon.

Government Office of the Capital City Budapest [BFKH], Budapest.

Instituto Nacional de Tecnología Industrial [INTI], San Martín, Prov. Buenos Aires.

Kenya Bureau of Standards [KEBS], Nairobi.

National Metrology Centre, Agency for Science, Technology and Research [NMC, A*STAR], Singapore.

National Physical Laboratory of Israel [INPL], Jerusalem.

State Enterprise "All-Ukrainian State Scientific and Production Center of Standardization, Metrology, Certification and Consumer' Rights Protection" [SE "Ukrmetrteststandard"], Kyiv.

Liaisons

Cooperation on International Traceability in Analytical Chemistry [CITAC].

European Commission – Joint Research Centre [JRC-Geel].

International Atomic Energy Agency [IAEA].

International Federation of Clinical Chemistry and Laboratory Medicine [IFCC].

International Organization for Standardization, Committee on Reference Materials [ISO REMCO].

International Union of Pure and Applied Chemistry [IUPAC].

1. OPENING OF THE MEETING

The Consultative Committee for Amount of Substance: Metrology in Chemistry and Biology held its 30th meeting at the International Bureau of Weights and Measures (BIPM) headquarters, at Sèvres, and on-line, on 10 and 11 April 2025.

The following attended:

Members

H. Andres (METAS), K. Arrhenius (RISE), T. Asakai (NMIJ/AIST), Y.-K. Bae (KRISS), M. Bilsel (UME), A. Botha (NMISA/ISO-REMCO), S. Bouchet (METAS), J. Braybrook (LGC), P. Brewer (NPL), R.J.C. Brown (NPL), S.Z. Can (UME), J. Carney (NIST), V. Delatour (LNE), F. Dewi (HSA), F. Dias (IPQ), L. Dong (NIM), Z. Durisova (SMU), S. Ellison (LGC/IUPAC), C. Engelhard (BAM), M. Fernandes-Whaley (NMISA), P. Fisicaro (LNE), H. Goenaga Infante (LGC), C. Gonzalez (NIST), N. González Rojano (CENAM), K. Inagaki (NMIJ/AIST), N. Itoh (NMIJ/AIST), J.S. Jung (KRISS), Y.A. Kustikov (VNIIM), J.V. Lara-Manzano (CENAM), K.-S. Lee (KRISS), L. Liv (UME), D. Markus (PTB), M.N. Medeiros (INMETRO), J. Melanson (NRC), Z. Mester (NRC/IUPAC), M.J.T Milton (Director of the BIPM), S.Y. Ng (HSA), J. Noireaux (LNE), G. O'Connor (PTB), C. Palma (IH-LQPM), S.R. Park (President of the CCQM/CIPM/KRISS), M. Pérez Urquiza (CENAM), R. Quendera (IPQ), T. Ren (NIM), C. Rimmer (NIST), J.M. Rodrigues Caixeiro (INMETRO), A.M. Rossi (INRIM), H. Salouros (NMIA), M. Sega (INRIM), K. Segelcke (DFM), K. Shearman (NIMT), D. Smeulders (NMIA), E. Sobina (UNIIM), R. Stosch (PTB), T.L Teo (HSA), M. Valkova (SMU), A. van der Veen (VSL), M. Vonsky (VNIIM), D. Wang (NIM), E. Yildirim (RISE).

Observers

Y. Cui (NMC, A*STAR), J. Dumanska (GUM), T. Fernández Vicente (CEM), F.M. Kai (NMC, A*STAR), B. Koleva (BIM), W.O. Lee (GL), C. Luvonga (KEBS), D. Nagy (BFKH), Z.N. Nagyné Szilágyi (BFKH), N. Oganyan (VNIIFTRI), A. Petrenko (SE "Ukrmetrteststandard"), M.M. Puelles (INTI), A. Rojo Esteban (CEM), H.K. Rotich (KEBS), L.N. Santos (INTI), N. Singh (NPLI), T. Stolboushkina (VNIIFTRI), M. Strzelec (GUM), Y. Tarasenko (SE "Ukrmetrteststandard"), S. Tripathy (NPLI), W.-F. Wong (GL).

Liaisons

F. Camin (IAEA), C.M. Cobbaert (IFCC), R. Koeber (JRC-Geel).

Representatives of Institutes from Member States invited to attend as Observers

J.H. Pulido Vargas (INM Colombia), I. Tahoun (NIS).

Guests

A.R. Al Askar (SASO-NMCC), E. Alasonati (LNE), B. Calderón Jiménez (LACOMET), M. Cleveland (NIST), N. Fathi Shehata (NIS), B. Fu (NIM), W.-H. Fung (GL), J. Huggett (LGC), Å. Jämting (NMIA), S. Lee (KRISS), T. Näykki (MIKES-SYKE), M. Panteghini (JCTLM), M. Ryadnov (NPL), S. Seitz (PTB), A. Shard (NPL), C. Swart (PTB), L.-L. Tay (NRC), M. Winchester (NIST), L. Wu (NIM).

Also present

M. Bedu (BIPM), R. Josephs (BIPM), G. Martos (BIPM), R. Wielgosz (BIPM, Executive Secretary of the CCQM).

2. Appointment of a Rapporteur and approval of the agenda

Dr Wielgosz asked Dr Cleveland to serve as Rapporteur. The meeting confirmed the appointment of Dr Cleveland as rapporteur. Dr Park presented the proposed agenda (*CCQM/2025-01*), which was adopted without change.

3. Opening remarks of the CCQM President and actions from the 29th meeting of the CCQM

3.1. Opening Remarks

Dr Park reviewed the history and growth of CCQM over the past 30 years. The initial meeting of the CCQM in 1995 had only 20 participants, but in recent years the CCQM has grown to over 300 participants. Dr Park noted that Dr Kaarls had established chemical metrology and Dr May expanded toward biometrology. During Dr Park's tenure as CCQM President, the CCQM has contributed to fighting global threats. Dr Park then outlined CCQM's strategic aims from 2021-2030. He noted that the CIPM has identified seven grand challenges, which are well represented in CCQM working groups. Dr Park reviewed the work of recent CCQM task groups, such as food measurement, Li-ion batteries and nano- and microplastics. Dr Park expressed his appreciation for the contributions of all CCQM members.

3.2. Review of Actions

Dr Wielgosz reviewed the actions from the 29th meeting of the CCQM. The list of actions agreed at the meeting is available separately as document (*CCQM/2024-59*) and was appended to the Report of the 29th meeting of the CCQM. Most actions were complete and those that were outstanding were addressed in the meeting agenda.

4. Plans for the 150th anniversary of the Metre Convention

[*CCQM/2025-41*] Dr Milton presented a report from the BIPM. The BIPM currently has 64 Member States and 37 Associate States, with 109 of 193 UN Member States participating in the BIPM's activities. A 150th celebration session will be held at the UNESCO headquarters in Paris on 20 May 2025. Participants must register to attend in person. (https://thebipm150.org/). Dr Milton noted that 375 posters were accepted, a book will be published and a commemorative porcelain vase has also been designed. Following the gathering at UNESCO, there will be a conference in Versailles 21-22 May 2025, with sessions on quantum technology, environment and climate, and digital transformation.

A metrology summer school has been organized in Varenna, Italy, on 9-18 July 2025. It will cover future needs for metrology including climate science, quantum technologies, and the digital transformation. These workshops are only organized every 5 to 6 years.

4.1. Plans for *Metrologia*

Dr Milton announced that *Metrologia*, founded by the BIPM in 1965, will become fully open access. Additionally, the CIPM recommended the creation of separate entity for the publication of comparison reports and asked the BIPM to identify and implement an appropriate mechanism for this. Until recently, this was how key comparisons were cited, but now DOIs can be used instead. A process for this is being developed, and every report will have a landing page.

5. Reports from CCQM Task Groups including outcomes of workshops

5.1. CCQM Task Group on Food Measurement (CCQM-TG-FOOD): Progress Report

[*CCQM/2025-42*] Dr Melanson reviewed the terms of reference for the task group. The CCQM-TG-FOOD was established in response to the CIPM strategy and is covering food related activities within all working groups. There has also been interest from other CCs (CCT, CCPR, CCM, CCRI). Dr Melanson reviewed the outcomes from the workshop, which covered challenges with authenticity, country of origin, novel foods and emerging contaminants. There is a need for reference materials for protein content in novel foods; the current methods rely on total nitrogen content as a proxy for protein content, potentially with a correction factor for different matrices. Currently, the biggest challenges for the TG are PFAS and microplastics. The TG is holding monthly meetings with a goal of submitting a draft report by January 2026. Dr Melanson also noted that the 16th International Symposium on Biological and Environmental Reference Materials (BERM 16) will be held on 1 to 4 June 2025 in Halifax, Nova Scotia, Canada.
Dr Goenaga Infante asked if the task group included nanomaterials as food additives, Dr Melanson replied that they could include this topic. Dr Wielgosz asked if other CCs were working on food related activities as a CC or if the food related activities are occurring within the NMIs that belong to those CCs. Dr Melanson replied that the CCs have the potential for further food-related work in the CCs but it is not currently well defined.

5.2. CCQM Task Group on Nano- and Microplastics Measurements and Standards (CCQM-TG-NMMS): Report and workshop outcomes

[*CCQM/2025-29*] Dr Jamting reviewed the formation of the TG and timeline. She gave an overview of the stakeholder workshop that was held in February 2025. The workshop included regulators, metrology programmes, government, researchers, and CCQM TGs. A survey conducted in 2022 was re-used for 2025 to see how attendee representation and areas of interest have changed. The 2025 workshop had more participation from non-NMI stakeholders. In 2022, there was more interest in the identity of the particles, whereas in 2025, there was more interest in the particle

number and mass concentration. The TG is conducting a survey to gauge interest in a pilot study on microplastic and nanoplastic characterization. So far, the TG has received nine responses from eight institutes (NIM, NRC, LGC, NMIA, NIMT, LNE, Kingston University London, INRIM). The survey asked if the institutes would be willing and able to participate in a pilot study involving microplastics or nanoplastics and 88 % of respondents stated that they would be able to. Dr Jamting proposed the terms of reference for the TG, which plans to continue liaison with experts, researchers and regulators to further assess priority needs in relation to the metrology community. She asked for a one-year extension for the TG. Dr Wielgosz stated that historically TGs had been able to focus their activities by selecting a high-priority measurement comparison to focus on. He advised that the terms of reference be revised to include delivering a protocol for at least one comparison that could be progressed within the CCQM. The revised terms of reference will be presented to the SPWG for discussion amongst WG and TG chairs. The CCQM approved the one-year extension for the TG. Dr Shard asked how important the stakeholders believe speciation is. Dr Jamting replied that stakeholders believed they were able to identify species, so at this time they are more interested in particle size and concentration. Dr Bae noted that it would be helpful to see an outline of all the particle studies taking place throughout the WGs.

5.3. CCQM Task Group on Infectious Disease Diagnostics and Metrology for Pandemic Preparedness (CCQM-TG-PANDEMIC): Progress Report

[*CCQM/2025-43*] Dr Braybook reviewed the background and terms of reference of the TG. The first fire drill of the TG was completed in the CCQM Working Group on Nucleic Acid Analysis (CCQM-NAWG) in 2024. H5N1 (Avian influenza) was used as a model, with generally good agreement between laboratories. In addition to the measured values, the study also examined the time it takes for each step to be completed (such as assay design, probe/primer delivery, control molecule delivery, assay optimization, etc). The next fire drill will take place in the CCQM Working Group on Protein Analysis (CCQM-PAWG); it is expected to start in 2025 with a report in 2026. For this study, participants will prepare solutions of a certain concentration, which will be measured by the pilot laboratory. There have also been discussions about potential studies within other WGs, such as the CCQM Working Group on Electrochemical Analysis (CCQM-EAWG).

The eLearning modules have been delayed but will hopefully be delivered by the end of May. NMIs are still welcome to contribute brief vignettes regarding how their institute responded during the pandemic by delivering nucleic acid-based reference materials. The TG will continue until the knowledge transfer/eLearning modules are completed, likely within the next couple months.

Dr Wielgosz noted that the BIPM and International Federation of Clinical Chemistry and Laboratory Medicine (IFCC) president plan to write jointly to the World Health Organization (WHO) to re-establish contact between the BIPM and WHO. The CCQM approved continuing the TG until the eLearning modules are completed.

5.4. CCQM Task Group on Metrology for Li-ion batteries (CCQM-TG-LI-ION): Progress Report

[*CCQM/2025-44*] Dr Seitz noted that activities related to Li-ion batteries are currently spread across CCs, so the objective of this TG is to identify and evaluate measurands and metrological services related to Li-ion battery technology. A list of potential measurands has been collected: state of health, water content, electrical impedance, dry electrode resistivity map, leakage resistance, chemical composition, purity of materials, and thermal parameters. There will be a stakeholder workshop 23-24 September 2025. NMIs and selected stakeholders will give presentations on quantities of interest, followed by discussions on relevance and priorities. This workshop is being organized in conjunction with a Versailles Project on Advanced Materials and Standards (VAMAS) project on Li-ion batteries. Dr Seitz requested a one-year extension for the TG, which was approved.

5.5. Activities of the CCQM Task Group on Gene Delivery Systems (CCQM-TG-GDS)

[*CCQM/2025-45*] Dr Braybrook presented the new TG which is intended to run from October 2025 through April 2027. He presented the Terms of Reference (*CCQM/2025-33*) for the TG, which will include measurands related to engineered viruses and viral vectors, as well as non-viral delivery methods (such as lipid nanoparticles). He noted that viral vectors are highly effective at delivering genetic material into cells and some can be targeted to specific cell types or tissues. Non-viral vectors are generally safer than viral vectors and are more versatile with the type of nucleic acid they can deliver. He explained that while titre is often measured, physical titre is often confounded with infectious titre.
Dr Braybrook stated that there is an ISO/TC 276 Biotechnology documentary standards activity related to gene delivery systems. The CCQM approved the TG.

5.6. Discussion on Task Group activities

Dr Braybrook noted that TGs have been very successful. Dr Wielgosz agreed that TGs have been very successful with engaging stakeholders, and the running of these groups required resources, which were currently being met through BIPM headquarters and NMI staff time. This was currently manageable, but if the number of groups were to increase significantly, additional support form NMIs would need to be sought, including staff secondments to the BIPM. Dr Park noted that TGs should have specific objectives in order to be successful. Dr Swart asked if TG could conduct studies or if only WGs could conduct studies. Dr Wielgosz said that traditionally the TG propose studies but WGs conduct them, though there have been cases where TG have conducted studies. Dr Brewer noted that inter-CC TGs, such as the CCQM-TG-FOOD, have been excellent collaborative tools for working with other CCs. Dr Park noted that TGs must have very clear and specific objectives in order to make sufficient progress.

6. CCQM Workshops and Sector Engagement

6.1. Update from the CIPM Sectorial Task Group on Climate and Environment (CIPM-STG-CENV)

[*CCQM/2025-46*] Dr Wielgosz presented the recent work of the CIPM-STG-CENV. There was an initial BIPM-World Meteorological Organization (WMO) workshop in 2022 which led to over 100 recommendations. The CIPM-STG-CENV was formed as a coordinating group, with the aim of finding other groups who were well suited to take on this work. The group held a recent stakeholder meeting in September 2024 to discuss progress and coordinate future activities. The meeting focused on metrology in support of the physical science basis of climate change and climate observations and on metrology as an integral component of systems measuring greenhouse gases. Participants had a favourable view of the meeting format and recommended that it occur biennially. One conclusion from the workshop is that there are many activities where metrology could play a role, but the majority are coordinated by other bodies, though there may be opportunities for NMIs to be involved. Dr Milton noted that to maintain the quality of this meeting, it could perhaps occur every three years instead of every two years.

6.2. CCQM Workshop on Digital and FAIR Chemical and Biological Reference Data and Certificates and proposal for a CCQM Digitalization Task Group

[*CCQM/2025-49*] Dr Gonzalez gave an overview on the advantages of digitalization. The CIPM created the Forum on Metrology and Digitalization (FORUM-MD) to advise the CIPM on the SI Digital Framework and the impacts of digital transformation on metrology and the international quality infrastructure. The first meeting was held in March 2024 and eight *ad hoc* WGs and TGs were created. A second meeting was held in February 2025.

Dr Gonzalez stated that the data challenges in the CCQM are completely different to those in the other CCs. Due to this, a workshop specific to chemical and biological reference data and certificates was held in September 2024. The goal was to develop recommendations for improving digital reference data and infrastructure. One of the main recommendations from the workshop was the formation of the CCQM Task Group on Data Digitalization (CCQM-TG-DD) with three teams: unique identifiers for chemical/biological data, digitalization of certified reference materials (CRM) certificates, and Findable, Accessible, Interoperable, and Reusable (FAIR) principles for databases. This TG would have a duration of three years. Dr Wielgosz noted that unique identifiers need to be addressed, with strong relevance for the KCDB and Joint Committee for Traceability in Laboratory Medicine (JCTLM) database, but asked if CCQM-TG-DD would have too much overlap with the FORUM-MD, with regard to digitalization of CRM certificates. Dr Wielgosz asked if FAIR principles/database activity should be reconsidered to include AI, including whether AI could review Calibration and Measurement Capabilities (CMC) claims. Dr Gonzalez agreed that AI should be included, he noted that the FORUM-MD has an AI group, but it is more focused on safety and security, so including AI within the CCQM-TG-DD would complement these efforts. Dr Gonzalez stated that the CCQM-TG-DD planned to work with the FORUM-MD group on digitalization of CRM certificates. Dr Swart

noted that CCQM will need to make reports machine readable. Dr Gonzalez proposed starting activities with very standardized CMCs, such as the CCQM Working Group on Gas Analysis (CCQM-GAWG) or purity and calibration solutions in the CCQM Working Group on Organic Analysis (CCQM-OAWG). Dr Milton noted that most of the access of BIPM data is by Google, OpenAI, and other similar systems. The CCQM approved the formation of the CCQM-TG-DD with the terms of reference to be updated by Dr Gonzalez and Dr Wielgosz.

6.3. CCQM Workshop on Protein Structure and Activity

[*CCQM/2025-48*] Dr Ryadnov reviewed the aims and attendance of the recent workshop on higher-order protein structure and protein activity. There were 130 participants and 20 speakers. After the workshop, a questionnaire was sent to participants to gather feedback. The outcome of the workshop will be a publication, likely as a perspective or a comment. Dr Ryadnov reviewed the protein activity TG that exists within the CCQM Working Group on Protein Analysis (CCQM-PAWG) and potential studies related to higher order structure. Dr Ellison questioned if higher order structure studies would fit within the current framework of CCQM studies, where a value and uncertainty are reported.

6.4. Report from the Joint Committee for Traceability in Laboratory Medicine (JCTLM)

[*CCQM/2025-76*] Dr Panteghini gave an overview of the JCTLM database and the structure of JCTLM, which is funded jointly by the BIPM and IFCC, with the database containing over 800 entries for Reference Materials, Methods and Services that can be used by the *in vitro* diagnostic (IVD) industry to implement metrological traceability and meet regulatory requirements. JCTLM has an annual nomination and review cycle, with around 100 nominations annually. There are 12 review teams with expert reviewers. He highlighted the importance of commutability of reference materials in this field, whereby they perform identically to human samples when analysed, and the guidance developed by IFCC to demonstrate this property. He described the concept of 'Maximum Allowable Uncertainty' for clinical field measurements, and how this in turn restricted the uncertainty that could be acceptable for reference materials or methods. A recent study within the JCTLM of thirty commonly measured clinical analytes, that were listed in the JCTLM database and also covered by CCQM WGs, concluded that for 28 of the magnitude of the measurement uncertainty met minimum requirements, but for two, serum albumin and chloride, further reductions in measurement uncertainty were desirable. He urged the CCQM PAWG and CCQM Working Group on Inorganic Analysis (CCQM-IAWG) to address these issues in their activities. He also had identified a number of a common analytes for which commutable reference materials were missing and would be useful, notably: total protein; 25(OH)D3; total haemoglobin; chloride; ALT; AST; LDH and bilirubin. He highlighted the challenges that the 7-year absence of a primary reference material for bilirubin had created and the utility of at least one more source of a primary CRM for bilirubin and the need for a matrix CRM. The next JCTLM Members' and Stakeholders' meeting and Workshop will be held 1-2 December 2025.

6.5. Report from the International Federation of Clinical Chemistry and Laboratory Medicine (IFCC)

[*CCQM/2025-49*] Dr Cobbaert covered the mission of the IFCC and current challenges that IFCC faces. One challenge is determining whether a clinical test is fit-for-purpose. A second challenge is individual variability in response to treatments. The third challenge is the existence of "silos" within diagnostic disciplines (i.e. radiology and pathology do not consult with one another). Additionally, stringent regulations, such as excessive certification costs and fragmented governance, threaten patient care and medical innovation. In the EU, this is leading to a call for *in vitro* diagnostic regulation (IVDR) reform.

6.6. Discussion on CCQM activities in support of Laboratory Medicine

Dr Huggett noted that the IVDR rollback is occurring, and that metrological traceability is a requirement in the IVDR. Dr Cobbaert stated that there was a need to educate all stakeholders including the IVD industry, laboratory professionals, EQA organizers and regulatory authorities about traceability and measurement uncertainty, as these concepts are often misunderstood. It was noted that there are difficulties in applying these standards to innovative fields like 'omics.

7. CCQM Strategy

7.1. Progress with update on the CCQM 2021-2030+ strategy

Dr Wielgosz stated that CCQM has been working on reviewing its strategy and extending it until 2034. Most of the WGs decided to update their strategies except for IAWG and the CCQM Working Group on Isotope Ratios (CCQM-IRWG). NAWG and OAWG have not yet completed their updates, but he hoped all WG updates will be complete by 15 May 2025 so that the overall CCQM strategy update can be published by 15 June 2025. For 2021-2030, 33 activities were identified and one additional activity, multi-omics, has been added for the 2025-2034 strategy. Overall, WGs are keeping pace with the expected number of key comparisons and pilot studies. He reviewed the work accomplished that was in line with CCQM's strategic goals, such as the resolution of global challenges, promoting the update of metrologically traceable chemical and biological measurements, and progressing the state of the art of chemical and biological measurement science. One of the strategic goals is to support the development of capabilities at NMIs and DIs with emerging activities; OAWG and GAWG have both established TGs on Capacity Building and Knowledge Transfer (CBKT) in support of this aim.

7.2. Discussion on CCQM Strategy updates

Dr Dong commented that she was very excited to see "omics" included in the latest version of the strategy document and asked how it would be incorporated in the WGs. Dr Wielgosz replied that usual practice would be to start with a workshop that would identify needs and trends in the area and conclude with recommendations where CCQM activities could progress the development of metrology in the area. It was decided that the "omics" workshop would be at the CCQM level since it involves NAWG, the CCQM Working Group on Cell Analysis (CCQM-CAWG), PAWG, and

OAWG. Dr Wielgosz will follow up with members to initiate the organization of the workshop.

8. Reports from the CCQM Working groups

8.1. CCQM Working Group on Organic Analysis (CCQM-OAWG)

[*CCQM/2025-34*] Dr Fernandes-Whaley gave an update on the OAWG. She summarized recent OAWG meetings and workshops; for most meetings, OAWG has about 100 participants, with approximately one-third attending in person. OAWG is undertaking many studies covering high purity calibrators, as well as the food, clinical and environmental sectors. Since April 2024, OAWG has published five reports in the KCDB. Two studies are currently in the Draft A stage, CCQM-K180 (Metronidazole in pig muscle) and CCQM-K184 (PAHs in sediment). CCQM-K192 (17β-estradiol in serum) is currently in progress and OAWG is requesting permission from the CCQM to allow eight expert laboratories to participate in this study. CCQM-K154.e (Ochratoxin A in acetonitrile) and CCQM-K148.c (Organic Purity Assessment-Digitoxin) are scheduled to begin in 2025. The OAWG is slightly behind schedule in running comparisons for a variety of reasons, including delays associated with the COVID pandemic, challenges with sourcing pure materials for studies, challenges sourcing calibrators and studies that required additional investigations before reports could be finalized. One study, K192 (β-estradiol) required extra work to test for commutability and align with stakeholder needs. Dr Fernandes-Whaley mentioned that the recent online workshop regarding nano- and microplastic measurements was of great interest to the OAWG environmental sector. She also discussed the recent quantitative nuclear magnetic resonance (qNMR) workshop.

8.2. CCQM Working Group on Inorganic Analysis (CCQM-IAWG)

[*CCQM/2025-30*] Dr Winchester presented an update on the IAWG, which focuses primarily on elements, including elemental speciation and organometallics. IAWG typically has around 100 attendees at the virtual meeting in November, with about 70 at the hybrid meeting at the BIPM headquarters in April. The IAWG recently implemented a policy document to track decisions and procedures, complementing CIPM and CCQM rules. The IAWG has been using the NIST Decision Tree for KCRV and DOE value assignments for the last year, which has expedited the process and allowed IAWG to completely finish four comparisons. Dr Winchester reviewed the IAWG Core Capability Matrix chart. IAWG has had discussions regarding CMC claims, resulting in the formation of a new TG within IAWG on Refining CMC guidance. This TG will update the IAWG guidance and processes for making and judging CMC claims and its recommendations will be presented at the November 2025 IAWG meeting. The IAWG has recently begun studies to advance particle metrology, including CCQM-K166/P210, CCQM-P222, and CCQM-P244. Additionally, IAWG and SAWG have a joint TG on particle metrology, which resulted from the 2022 Particle Metrology Workshop. This TG aims to liaise with external stakeholders to better understand the needs and gaps and produce a written report to identify activities that IAWG/SAWG should undertake regarding particle metrology. Dr Winchester stated that perhaps the CCQM should consider a higher level of coordination for particle measurements, since the work is spread across many WGs. Dr Winchester

reviewed ongoing and upcoming studies in the IAWG and how these fit into the five-year plan for IAWG.
Since IAWG and SAWG already collaborate on particles, it was decided that Dr Winchester and Dr Shard will work together to develop a proposal on coordination of activities on particle related studies across CCQM WGs for consideration by the SPWG.

8.3. CCQM Working Group on Gas Analysis (CCQM-GAWG)

[*CCQM/2025-07*] Dr Brewer reviewed the work of the GAWG over the past year and noted that the GAWG works in close coordination with the IRWG. In conjunction with the 2024 GAWG meeting at KRISS, a two-day workshop was held, focusing on greenhouse gas monitoring initiatives. GAWG members also participated in several other related meetings such as the ISO/TC158 and Gas Analysis Workshop with Industry and the CIPM-STG-CENV Stakeholder Meeting. GAWG has recently published several comparisons including BIPM.QM-K1 (Ozone), CCQM-P229 (Line Intensities of Selected $^{12}C^{16}O$), and SIM.QM-S6 (Automotive), with several other comparisons nearing completion.
Dr Brewer reviewed GAWG's strategy to remove CMCs from the KCDB when these CMCs have insufficient or obsolete evidence. GAWG considers archiving a comparison when a replacement comparison is published or when the comparison was published more than 15 years ago. Dr Brewer reviewed current TGs within GAWG: ozone cross-section change, guidelines to support new CMCs, isotope ratio metrology, greenhouse gas scales, advanced spectroscopy, aerosol metrology and passivation chemistry. He also reviewed the changes to GAWG's strategy document; the updated strategy includes a new measurement infrastructure for underpinning atmospheric observations of key greenhouse gases, global implementation of a new reference value for more accurate measurements of ground-level ozone, and underpinning hydrogen fuel quality. GAWG will hold its next meeting on 21-22 October 2025, at INRIM, in conjunction with a Passivation Chemistry Workshop.

8.4. CCQM Working Group on Isotope Ratios (CCQM-IRWG)

[*CCQM/2025-25*] Dr Mester presented the recent activity in the IRWG. IRWG was formed in 2018 and has members from 24 NMIs/DIs. IRWG meetings typically have about 50 participants, with half attending virtually. One of the main objectives of the IRWG is a better periodic table, with more accurate atomic weights. IRWG, in collaboration with OAWG, is planning a hybrid workshop on Site Specific Isotope Ratio Measurement for April 2026. IRWG formed a TG on Quantities, Units and Symbols in 2022 to define basic nomenclature; the recommendation from this TG was published in 2023. IUPAC recently initiated a project to disseminate this nomenclature. The 2024 IAEA Experts Meeting released a publication regarding consensus for Stable Isotope Reference Materials and Scale Definitions (https://doi.org/10.1002/rcm.10018), which Dr Mester asked the CCQM to consider endorsing. He also asked for an extension to the BIPM Chemistry Department Programme to develop a database based on FAIR data principles to support the isotope ratio measurement community. IRWG is currently conducting several studies: CCQM-K183/P234, CCQM-K182/P233, CCQM-K193/P247, and CCQM-P239. Additionally, IRWG is planning a study for Sr isotope ratios in cereal and a study on

compound specific carbon and nitrogen delta measurement in synthetic mixtures. Dr Wielgosz asked the IRWG to form a TG to clarify resources necessary to develop a database and provide a draft for incorporation into the draft BIPM headquarters' future work programme. Regarding endorsement of the IAEA publication, Dr Wielgosz stated that the CCQM should be given time to review the publication before deciding whether to endorse the recommendations and it can be decided at the April 2026 meeting.

8.5. CCQM Working Group on Surface Analysis (CCQM-SAWG)

[*CCQM/2025-31*] Dr Shard reviewed the remit of SAWG, which is to conduct Key Comparisons and Pilot studies for spatially resolved chemical analysis at the micro- and nanoscale to improve traceability in this field. SAWG has 33 participants from 19 countries. SAWG's primary aims are accurate measurement of chemical composition and amount of substance in thin films, layers and coatings, metrological understanding of methods used to map or image chemistry on the lateral scale length of less than 1 mm with high-lateral resolution, development of a metrology infrastructure for the chemical measurement of nanostructured and highly porous materials, and development of chemical metrology for nanoparticles in concert with other working groups. Recently, SAWG has added a fifth aim, which is to develop the metrology infrastructure and highest point of reference for nanoscale chemical measurements in support of advanced semiconductor and quantum applications. SAWG is well engaged with the community, including ISO and VAMAS. SAWG proposed the establishment of a TG within SAWG for graphene and 2D materials. Dr Wielgosz asked if there was any overlap between this work and the work of the CCEM; Dr Shard replied that CCEM does not measure these types of samples but the quality of the devices relies on chemical measurements. Dr Shard further noted that SAWG had established links with the CCEM and will work with them to make sure the work is supportive and complementary.

8.6. CCQM Working Group on Protein Analysis (CCQM-PAWG)

[*CCQM/2025-08*] Dr Swart reviewed recent PAWG meetings, including a workshop at the PTB in October 2024, focused on standardization of pathogen measurements. PAWG is updating their strategy; they have updated models for purity and matrix studies and will now include studies on protein structure and activity. In addition to the qualitative and quantitative analysis of peptides and proteins in complex biological matrices and biopharmaceuticals, PAWG has added the analysis of peptides and protein in food. PAWG has undertaken several activities related to stakeholder engagement, such as workshops and studies organized in conjunction with IFCC, WHO, Centers for Disease Control and Prevention (CDC) and reference material producers. There are three TGs within PAWG, focused on peptide and protein purity, peptides and proteins in complex matrices, and protein structure and activity. Additionally, PAWG members contribute to TG-FOOD and TG-PANDEMIC. Dr Swart reviewed ongoing and recently completed studies in PAWG including CCQM-P219 (HbA1c), CCQM-K177 (human growth hormone), CCQM-K186/P239 (total haemoglobin), CCQM-K115.d/P55.2 (PTH 1-84). PAWG also plans to begin the fire drill study in September 2025, which will provide evidence-based assessment of NMI/DI capability to deliver a rapid response for protein reference materials.

Participating laboratories will be asked to generate or locally source a protein with a specified sequence and value assign this material. The pilot laboratory will then measure the content of the vials (Type II interlaboratory comparison). The next meeting of the PAWG will take place 2-5 September 2025 in Maryland. After the presentation, Dr Cobbaert highlighted the clinical need for better measurement systems for specific proteins, such as human growth hormone.

8.7. CCQM Working Group on Cell Analysis (CCQM-CAWG)

[*CCQM/2025-10*] Dr Braybrook noted that 40 participants typically attend the CAWG, with about 12 in person and the rest online. He reviewed the terms of reference for the CAWG, which cover eukaryotic cells, prokaryotic cells, subcellular entities, viruses, and cell analogues (such as the P222 study). The measurands for the CAWG are typically cell number per unit of area or volume. Dr Braybrook highlighted the challenges in applying metrological principles to cellular measurements, including incomplete traceability chains and emerging stakeholder needs. CAWG has completed three studies and has four ongoing studies, Draft B reports are available for CCQM-P205 (Quantification of membrane intact *E. coli* in drinking water) and CCQM-P217 (Quantification of fixed PBMCs in suspension). CAWG is proposing four additional studies to commence in 2025 and 2026, covering *in silico* quantification of cell number per spheroid image, particle number concentration of extracellular vesicles, absolute count and ratio of T-cell immunophenotyping and enumeration of membrane intact E. coli. The next meeting of the CAWG will take place 2-5 September 2025 in Maryland.

8.8. CCQM Working Group on Nucleic Acid Analysis (CCQM-NAWG)

[*CCQM/2025-35*] Dr Huggett reviewed the focus of the NAWG, which covers the nucleic acid polymer sequence, modifications of the sequence and abundance of the sequence. NAWG has two hybrid meetings per year, with about 20 in person attendees and an additional 30 online. Dr Huggett noted that NAWG comparisons had historically focused on the foods area, but NAWG recently completed CCQM-K176 (Breast cancer biomarker HER2 copy number variation measurement) and CMC claims related to this diagnostic measurement are currently under way. NAWG has six studies currently ongoing, covering DNA methylation, cancer variants, authenticity of meat species, lipid nanoparticles with encapsulated RNA, and virus measurements. CCQM-K190/P249 will involve ratio measurements between the international standard for SARS-CoV-2 and two secondary materials. Future NAWG studies will cover cancer variants in liquid biopsies, SI traceability to the mole for nucleic acids, bacteria, viruses, environmental DNA and food testing measurements. With regard to SI traceability to the mole, NAWG is planning a study to provide support for non-molecular measurements of nucleic acids, such as IDMS and ICP-MS; this study would allow for broad claim CMCs for the chemical analysis of nucleic acid macromolecules. Dr Huggett asked the BIPM headquarters to consider a NAWG request to add DNA and RNA, at high and low molecular weights, to its calibrator programme. The next meeting of the NAWG will take place 2-5 September 2025 in Maryland. This meeting will also have a workshop covering advanced therapeutics.

8.9. CCQM Working Group on Electrochemical Analysis (CCQM-EAWG)

[*CCQM/2025-11*] Dr Seitz noted that NMI and DIs who are members of the EAWG provide a lot of CRMs that are very important to industry, such as for pH, coulometry, classical chemical methods and conductivity. The majority of key comparison and pilot studies in the EAWG focus on pH and coulometry, with a minority focusing on electrical conductivity. EAWG typically has about 15 in person participants and 30 online participants. Most EAWG members are from EURAMET and APMP. One current study, CCQM-K169, involves the assay of sodium oxalate, which is one of the key substances used as a reductant in titrimetry. Dr Seitz noted that there is an overdispersion seen in the CCQM-K169 results; similar to other CCQM WGs, EAWG is wondering how to deal with inconsistent results from a small number of participants. Due to geopolitical events, EAWG conducted several subsequent comparisons and regional comparisons. EAWG plans to conduct three additional pH comparisons and three coulometry comparisons. EAWG is asking CCQM to approve two key comparisons. EAWG has several working documents, including a key comparison record file to aid CMC reviewers. In the last year EAWG produced a draft guidelines document for the conduction of key comparisons, focusing on specific EAWG issues that are not covered by other guidelines. Dr Seitz proposed the idea of a CCQM-TG on biosensors, which would create a metrology framework to characterize signals from biosensors quantitatively but stated that he has been unable to locate anyone willing to chair this TG. Dr Seitz also noted that the EAWG TG on traceability of seawater pH_T measurement has released a discussion paper.

8.10. CCQM Working Group on Key Comparisons and CMC Quality (CCQM-KCWG)

[*CCQM/2025-16*] Dr Botha gave an overview of KCWG membership and thanked participants in the KCWG for their work. For the 2024 review cycle, 442 CMCs were published (out of 551 that were reviewed). For 2025, there are 720 CMCs to be reviewed. APMP and EURAMET have the majority of CMCs out of the Regional Metrology Organizations (RMOs). Of the WGs, GAWG, OAWG, IAWG submit the most CMCs. Current issues within KCWG include confusion about uncertainty convention, broad scope vs specific CMCs, lack of supporting evidence and WG guidance not being followed. KCWG proposes that WGs only use Uncertainty Convention 2. It is hoped that all the current CMCs can be published by September 2025. NAWG has proposed new CMC categories for DNA and RNA. CAWG has also proposed categories that will be needed for cells. KCWG was also asked to provide guidance on how to write CMCs and KCWG has formed a TG to create an eLearning module that will address this (led by Dr Lewin). Dr Wielgosz proposed that there be a strong link between that TG and the digital TG, which is looking into the feasibility of AI review of CMC review. Dr Seitz asked if there was still an opportunity to discuss the use of Uncertainty Convention 1, as this convention is often used by EAWG. Dr Botha noted that it was still possible for WGs to use Uncertainty Convention 1.

8.11. BIPM headquarters Programme on Metrology in Chemistry

[*CCQM/2025-22*] Dr Wielgosz presented recent achievements and future plans for the BIPM Chemistry programme. The BIPM headquarters has several roles, including as a comparison coordinator, in knowledge transfer and as a liaison hub and coordinator.

The BIPM Chemistry Department supports the CCQM strategy by providing the Executive Secretary Role, coordinating comparisons, offering knowledge transfer programmes for National Metrology Institutes (NMIs), maintaining the JCTLM database, and supporting engagement with stakeholders. The BIPM coordinated CCQM comparisons for various areas, including greenhouse gases and air quality gases, isotope ratio measurements, small organic molecules, and peptides and proteins. The BIPM also conducts laboratory-based activities to build capacity and transfer knowledge in areas like Metrology for Safe Food and Feed, Clean Air, Pesticides and Veterinary Drugs, Dynamic standards for Air Quality Gases, and Pure peptides for Laboratory Medicine. Dr Wielgosz mentioned that Dr Westwood, who supported a number of activities in organic analysis, retired last year, and he thanked him for his dedicated service to the BIPM. Dr Robertson joined the BIPM in 2024 and has already made impacts related to qNMR. Additionally, the BIPM offers visiting scientist placements, online eLearning modules, and summer schools, having organized its first summer school on qNMR in 2024. The BIPM is currently working on machine-readable databases with FAIR principles, starting with a database for CO_2 scale comparisons. The BIPM will also be producing certified reference materials for CO_2 isotope ratio measurement services until NMIs are ready to take over this service. NAWG recently requested assistance from the BIPM for DNA and RNA calibrators, and the BIPM will work with NAWG to incorporate nucleic acid calibrator comparisons into their future proposed work programme.

The BIPM currently has a secondment opportunity for organic analysis (*CCQM/2025-23*), starting in September 2025, lasting for 6 months. Additionally, there is a secondment opportunity for a JCTLM Global Learning and Outreach Specialist for 18 months, starting September 2025, ending June 2027. There is a job vacancy for a technician in analytical chemistry.

8.12. CCQM Task Group on Guidance for the estimation of a consensus KCRV (CCQM-TG-KCRV)

[*CCQM/2025-38*] Dr Ellison reviewed the purpose of this TG, which is to review and update the CCQM guidance note CCQM13-22, “Estimation of a consensus KCRV and associated Degrees of Equivalence”, in the light of experience gained since its publication. The main factors affecting KCRV choice are bio/chemical measurement expertise, overdispersion outliers, asymmetry. The TG is currently considering a draft second edition of the guidance, which will include a flowchart ‘decision tree’ for selecting a specific KCRV estimator, graphical inspection tools (such as consistency plots and median scaled difference), stronger consideration of asymmetry, recommendations of current Bayesian estimators, amended priority order of general criteria for KCRV estimators, and recommendations for considering “dark uncertainty”. Dr Ellison outlined a multi-step process for KCRV determination, emphasizing the iterative nature of data review and KCRV calculation. A significant aspect of the updated guidance is the recommendation for a default KCRV model

that accounts for over-dispersion (dark uncertainty), as statistical tests often fail to detect it. The draft also suggests that key comparison reports should comment on over-dispersion. Tentative new points include advising participants against inflating claimed uncertainties without technical justification and noting that deviations in degrees of equivalence might not solely be due to uncertainty. Dr Ellison concluded by outlining the next steps, including reviewing and updating the draft, finalizing the flowchart, and producing a consultation draft. He posed two key questions for the group: whether guidance on CMC claims should be included in this document or in KCWG documentation, and whether worked examples should use real, potentially problematic, published data or synthetic data. Dr Seitz said institutes just want to know the minimum uncertainty they can claim to be accepted by the reviewers, and this is what the guidance should cover.

8.13. CCQM *ad hoc* Working Group on the Mole (CCQM-ah-WG-Mole)

[*CCQM/2025-06*] Dr Brown presented the updated terms of reference for this WG. The membership of the working group was refreshed, with nominations from each WG now finalized, and available on the website. The updated terms of reference for the *ad hoc* group focus on reviewing and updating the *mise-en-pratique* for the definition of the mole, providing advice to the CCQM on the mole and related units in chemistry and biology, and offering similar guidance to a wider range of stakeholders. The WG reviewed and updated the *mise-en-pratique (CCQM/2025-14)*. Key changes include aligning nomenclature with the latest version of the SI brochure, clarifying the distinction between the Avogadro Constant and the Avogadro number, clarifying that the silicon sphere experiment provides the practical realization of the definition of the mole with the smallest uncertainty in macroscopic samples, adding technical details on electrolysis, and updating the value of the dalton. The presentation also noted the release of version 3.01 of the 9th edition of the SI brochure with clarifications on angle and quantities with the unit one, and an upcoming version 3.02 to update the dalton's value. There is a new TG on Terms, Quantities and Units for Bioanalytical Measurement (TG-TQUB), chaired by Dr Huggett. This task group, comprised of volunteers from bioanalysis working groups and external stakeholders, has established its terms of reference. Its objectives include consulting with the stakeholder community to identify key units and quantities in bioanalysis relevant to the CCQM, reviewing the literature for the terms used to represent these units and quantities, and producing a harmonized document for application in CCQM outputs. A longer-term goal is to engage with ISO/TC 12 to formalize this document as a new work item, potentially producing a ISO 80000 series standard from it in the future. The task group has made good initial progress, including stakeholder recruitment and commencing its consultation and literature review phases, aiming for completion by September 2025. Future plans for the working group include the task group continuing its work on harmonization, ongoing dialogue with IUPAC regarding the Gold Book entry for elementary entity, and involvement in their Green Book update, and providing *ad hoc* advice to stakeholders.

The CCQM approved the *mise-en-pratique*.

8.14. Approval of proposals for CCQM Comparisons

[*CCQM/2025-05*] There are 21 new pilot studies and comparisons, which are all consistent with the strategic plans on their respective WGs. The CCQM approved these studies.

9. CC Governance and Operational Issues

9.1. Questions on 'Overlapping broad and specific CMCs'

Dr Fernandes-Whaley stated that overall OAWG is adopting broad scope CMC claims, but OAWG occasionally sees specific CMCs submitted that overlap with broad scope claims. The intention for broad scope CMC claims was to cover a broader measurement range and reduce the workload on the reviewers, but ultimately the NMI decides what claim to submit. Some NMIs use the number of CMCs to determine NMI performance; a suggested alternative was to calculate the percentage of services covered by CMCs (e.g. 80 % of services covered by three CMCs). Specific claims have not yet been removed even though there are overlapping broad scope claims. CIPM states that NMIs cannot have more than one CMC for the same service. Dr Fernandes-Whaley asked the CCQM what the timeframe should be for switching to broad scope claims and if this issue would be lessened by digitalization and AI review of CMCs. Dr Swart commented that the broad claims also reduce the number of studies that must occur, which will not be reduced by digitalization and AI review.

Dr Melanson suggested that perhaps broad scope claims could include examples. There were many comments and the CCQM President decided that there should be a special session at the 2026 Plenary Meeting on this topic.

9.2. Issues with transport of comparison samples

Dr Swart presented recent issues with the transport of comparison samples, such as samples being stuck in customs and samples arriving thawed. When samples arrived thawed, they must be re-sent, leading to increased costs. The shipment of protein samples on cool packs or dry ice also leads to additional expenses for the coordinating laboratories. Prior to sample shipment, PAWG asks participating laboratories for information regarding documentation required for shipment, but each time there are still issues. She asked if other WGs could offer suggestions or solutions. The consensus was that unfortunately this happens regularly and there is no easy solution.

Dr Koeber stated that this happens often to reference material producers, including JRC, and that dry ice is preferred over cool packs. Dr Wielgosz noted that the comparison protocol should state how shipment costs are to be split between the coordinating laboratory and the receiving laboratory, and that these can be the responsibility of the receiving laboratory. Dr Braybrook noted that LGC occasionally has shipment issues as well and that it is helpful for the recipient to contact customs to expedite the clearance. Dr Milton approached the World Customs Union about this issue, and they noted they have a treaty for scientific equipment, but even to access this, one must be nominated by their government. Dr Wielgosz noted that that treaty applies to scientific equipment that is shipped and then shipped back (not a permanent export). Dr Winchester suggested NMIs could collaborate by

shipping to intermediate NMIs and coordinating laboratories could also consider liquid nitrogen shippers. Dr Fernades-Whaley stated that radioisotope samples can arrive within 24 hours because agreements have been worked out. She also noted that taking out insurance on the samples can help to ensure it is not a complete loss. Dr Botha noted there is a special customs code for certified reference materials, and it may be worth investigating how to obtain a special code for comparison samples. Dr Dong recommended finding a good logistics agency to help with the shipment, as well as strong communication with the receiving laboratory to understand their specific requirements and to let them know to expect the shipment.
Dr Swart proposed a TG to work on shipment issues and Dr Wielgosz asked Dr Swart to draft terms of reference to make sure the aims of the TG were clear.

9.3. Future process for re-review of CMCs and CMCs not supported by comparisons

Dr Botha stated the KCWG had completed the review of CMCs published prior to 2010. Next, the KCWG had planned to review CMCs approved 2015 or earlier, but there are nearly 1500 CMCs from this time period, prompting a revaluation of this strategy. It was emphasized that it is the responsibility of the NMIs and DIs to maintain CMCs, with the KCWG primarily serving an oversight role. Ideally, the KCWG would monitor new evidence relevant to CMC support and advise NMIs/DIs on necessary actions. As a step in this direction, representatives from the GAWG, IAWG and OAWG were tasked with considering how to implement this approach, identifying potential new evidence, and formulating advice for their respective working groups. The GAWG had already started to address this issue by archiving older comparisons. When a comparison is archived, the CMCs it supported would no longer be considered valid, triggering a review and update by the responsible institutes based on new evidence. The KCWG saw merit in extending this archiving strategy to other WGs to prompt the updating or removal of unsupported CMCs. The technical working groups were asked to consider comparison archiving to facilitate CMC updates. Recognizing that new comparison data might not always be available, the discussion shifted to "other evidence" that could support CMCs. Key criteria for such evidence were established: established methodological traceability, a documented uncertainty budget, and demonstrated comparability of measurement results. Parallel pilot studies and standalone pilot studies were identified as potential sources, though they might lack degrees of equivalence. Publications were also considered, albeit with the challenge of ensuring all three criteria are met. To further explore the concept of "other evidence" for CMC support, the KCWG proposed a dedicated workshop, which was approved by the CCQM.

9.4. Measurement Uncertainty

Dr Milton stated that the Joint Committee for Guides in Metrology (JCGM) is discussing updating the definition of “measurement uncertainty” in the 4th edition of the International Vocabulary of Metrology (VIM). The current definition is “non-negative parameter characterizing the dispersion of the quantity values being attributed to a measurand, based on the information used”. The new proposed definition is “doubt about the value of the measurand that remains after making a measurement”. Dr Milton noted that he asked JCGM to organize a webinar later this

year to explain the change to the community. Dr Wielgosz asked if this wording could imply, especially in applied areas such as clinical chemistry and forensics, that there was a lack of knowledge about the measurement. Dr Swart agreed that the term "doubt" may have negative implications for fields where decisions are questioned in court, such as forensics. Dr Ellison, a member of the working group which has proposed this change, stated that the rationale is that the approach to measurement uncertainty has changed over the years. Another approach for the new definition would be to remove the word "parameter" from the current definition. The committee is proposing this new definition so that the definition of measurement uncertainty will be more understandable to the general public. The committee also wanted to accommodate new ways of calculating measurement uncertainty, such as Monte-Carlo analysis, which looks at a complete distribution. Dr Park proposed a small discussion group, which Dr Wielgosz volunteered to lead. In this discussion group, the majority of participants opposed the change because the word "doubt" does not convey the notion that measurement uncertainty is a "well-defined limit of our knowledge of a value coming from measurement" and may lead people to question the validity of the measurement. It was also noted that a major change in definition requires consultation of the broader measurement community to assess both intended and unintended consequences of the change.
Dr Milton and Dr Park encouraged CCQM members to attend the webinar and offer feedback.

10. Reports from the RMOs

10.1. AFRIMETS

[*CCQM/2025-18*] Dr Botha gave a review of AFRIMETS' recent activities. There were 769 CMCs from AFRIMETS members as of March 2025. LNMC-INRAP (Tunisia) is developing its strategy for metrology in chemistry and is involved in bilateral and key comparisons. NIS (Egypt) has submitted new CMC claims in Chemistry and Biology for 2025, including measurement capabilities for anions in water and certified calibration solutions. AFRIMETS is supporting the Pan African Quality Infrastructure (PAQI) project, including proficiency testing schemes for cassava. NMISA has provided training on ISO 17034 for reference material production to Rwanda Standards Board (RSB), Kenya Bureau of Standards (KEBS), and the East African Community (EAC).

10.2. APMP

[*CCQM/2025-19*] Dr Lin Teo presented recent APMP activities. In 2024, APMP had 47 full members from 28 economies and 12 associate members from 12 economies. APMP Technical Committee on Amount of Substance members also participated in meetings of focus groups on climate change and clean air, food safety, clean water, and the APMP-Asia Pacific Accreditation Cooperation Joint Proficiency Testing Working Group. APMP TCQM has organized 15 key comparisons, 27 supplementary comparisons, and 37 pilot studies to date. Ongoing studies include key comparisons on formaldehyde in nitrogen and automotive emission gases, supplementary comparisons on gases and substances in various mediums, and pilot studies on

coliform in drinking water and trace elements in river water. Several workshops and webinars were held, including a joint workshop of the APMP Climate Change and Clean Air Focus Group and TCQM Gas Analysis Working Group in Zhengzhou, China. New capability building training sessions were planned for 2025-2026, including GMO measurement, CRM production, and a joint workshop with AOAC Southeast Asia.

10.3. COOMET

[*CCQM/2025-21*] Dr Kustikov presented recent COOMET activities. The TC 1.8 "Physical Chemistry" focuses on measurement services in metrology in chemistry and biology. It includes 22 NMIs from 17 COOMET member countries. In 2024, the main activities included preparing CMC data, internal and interregional CMC reviews, planning and organizing international comparisons and interlaboratory research, familiarizing members with CCQM and COOMET documents, improving the TC 1.8 structure, and providing metrological services. Several international comparisons and pilot studies are coordinated by VNIIM, UNIIM (branch of VNIIM), VNIIFTRI, and VNIIOFI. These projects cover various areas such as motor vehicle emissions, natural gas, mass fraction of carbon and sulphur in steel, nutritional value of food products (chocolate, milk powder, soy flour), gas permeability of rocks, raw gluten in wheat grain, pH of buffer solutions, Zeta potential, particle sizes in liquid and mass fraction of elements in pure metals.

10.4. EURAMET

[*CCQM/2025-13*] Dr Näykki presented recent EURAMET activities in the Technical Committee for Metrology in Chemistry (TC-MC). The TC-MC has 32 contact persons and six with observer status. It involves 23 European members (NMIs) and 20 associate members (A-DIs). There are four technical subcommittees: Gas Analysis, Inorganic Analysis, Bio and Organic Analysis, and Electrochemical Analysis. Several TC-MC studies have been completed or are ongoing, including comparisons related to PAHs in Protein Matrix, gold content in white alloy, forensic alcohol, nitrogen dioxide gas mixtures, critical elements in Li-ion battery black mass, and electrolytic conductivity. There are plans for a TC-MC summer school in August 2026, with a focus on bioanalysis and biometrology.

10.5. GULFMET

No report was received for GULFMET.

10.6. SIM

[*CCQM/2025-27*] Dr Calderón Jiménez presented the recent activities of SIM. The SIM Chemical Metrology Working Group supports metrology in chemistry and biology within the Interamerican Metrology System. They organize regional comparisons and pilot studies linked to the CCQM, facilitate the creation and maintenance of CMCs, and disseminate knowledge through training and workshops. The group involves 57 CIPM MRA participants and handles a large number of CMCs, key comparisons and supplementary comparisons across various fields like organic, inorganic, and gas analysis. In 2025, MWG-8 is planning projects such as ReMERSIM,

which focuses on developing traceable measurements for energy transition gases, and a NanoWorkshop. They also conduct training, including the SIM Metrology School 2024 in Bogotá, Colombia. The group's activities aim to ensure comparability and harmonization of measurements among member economies, ultimately enhancing measurement capabilities in the SIM region.

11. Discussion and questions on written reports from International Organizations in liaison with the CCQM

11.1. International Atomic Energy Agency [IAEA]

[*CCQM/2025-24*] Dr Camin presented the 2024 IAEA Activity Report which highlighted the IAEA's participation in various Working Group meetings, including Gas Analysis (GAWG), Isotope Ratio (IRWG), Organic Analysis (OAWG), and Inorganic Analysis (IAWG). The IAEA contributed to task groups, pilot studies, and key comparisons, focusing on isotopic measurements and metrological traceability. Notably, significant progress was made on defining carbon and oxygen isotope delta scales, and a template for scale definition was established. The IAEA also engaged in activities such as preparing reference materials, publishing technical documents on stable isotope ratio analysis, and initiating regional training centres for greenhouse gas monitoring. The report also details participation in specific comparisons and workshops related to various analytes in different matrices, demonstrating the IAEA's ongoing efforts in improving measurement capabilities and global comparability in isotopic and chemical analysis.

11.2. European Commission Joint Research Centre [JRC]

[CCQM/2025-26] Dr Koeber presented on the Joint Research Centre of the European Commission. JRC continues its work in various Technical Committees and European Metrology Networks, focusing on traceability in laboratory medicine and pollution monitoring. Despite some discontinued activities due to reorganization, the JRC remains active in CCQM working groups, participating in key and pilot studies such as those related to SARS-CoV-2 RNA, Influenza RNA, and RNA Lipid Nanoparticles. They are also involved in comparisons on foods, including lead and cadmium in cocoa powder and elements in pork powder, aiming to support CMC claims for element measurement in food. JRC is also coordinating a clinical key comparison on 17ß-estradiol in human serum, contributing to a study on C-reactive protein, and participating in the EURAMET project NeuroBioStand. They are active in reviewing CMCs and in the CCQM Task Group on Nano- and Microplastic Measurements and Standards. The JRC is a recognized reference material producer, collaborating with organizations like IFCC and participating in ISO and CEN technical committees. They offer around 700 different reference materials and maintain accreditation according to ISO/IEC 17025 and ISO 17034.

11.3. International Union of Pure and Applied Chemistry [IUPAC]

[*CCQM/2025-37*] No presentation.

11.4. ISO/TC 334- Reference Materials

[*CCQM/2025-28*] Dr Botha gave an overview of ISO/TC 334, which focuses on Reference Materials. ISO/TC 334 held their annual meeting online in June 2024 with 60-70 participants from various member bodies and organizations. The report highlights liaison activities with other ISO technical committees and international organizations, particularly focusing on the revision of ISO standards related to reference materials and *in vitro* diagnostic medical devices, as well as contributions to the International Vocabulary for Metrology (VIM). Furthermore, the report outlines the programme of work for ISO/TC 334, which involves transforming existing ISO/REMCO Guides into international standards within the ISO 33400 series. It discusses the progress of these standards, including those already published in 2024 and those still in development, such as ISO 33400 for terms and definitions related to reference materials. The document also touches on further relevant ISO initiatives like the SMART programme for digital transformation of standards, the use of the OSD platform for standards development, ISO's commitment to the UN Sustainable Development Goals, and actions to combat climate change through standards. The next meeting of ISO/TC 334 is scheduled to be held in conjunction with the International Symposium for Biological and Environmental Reference Materials (BERM-16) in Halifax, Canada, in June 2025.

11.5. Cooperation on International Traceability in Analytical Chemistry [CITAC]

[*CCQM/2025-20*] Dr Mester explained the mission of CITAC and announced the recent best paper awards. The award ceremony will be on YouTube and Zoom on 17 June 2025.

12. CCQM Meetings

12.1. CCQM WG meetings to be held in 2025

NAWG, CAWG and PAWG will hold meetings at NIST 2-5 September 2025. GAWG will hold a meeting 21-22 October 2025 at INRIM. OAWG will have an online meeting in September 2025. IAWG will hold an online meeting in November 2025. EAWG will have an online meeting 7-8 October 2025. SAWG will hold a virtual meeting in September 2025.

Dr Park reminded the CCQM of the benefits of on-site meetings at NMI/regional venues which included the opportunity to discuss measurement issues in greater detail, the opportunity to showcase metrology to the local stakeholder community, the opportunity to organize larger technical meetings for which the BIPM headquarters has limited facilities. He asked WG Chairs to work with their NMI members to identify opportunities for in person meetings and workshops.

12.2. Dates CCQM meetings in 2026 and 2027

The next CCQM meetings at the BIPM headquarters will be on 13-17 April 2026. The dates for the 2027 meetings are not yet determined.

13. Closing remarks from the CCQM President

Dr Park thanked participants and BIPM staff for their dedication and hard work. He noted the meeting was very fruitful and wished everyone a safe journey home.

Decisions and Actions

1) The CCQM **approved** the report of the 29th Meeting of the CCQM.
2) The CCQM **approved** a one-year extension for the TG on nano- and microplastics.
3) **Action:** Nano- and Microplastics Measurements and Standards Task Group to update terms of reference and planned outcomes for presentation to SPWG.
4) **Action:** Pandemic TG to finish the eLearning module so the TG can be closed out.
5) The CCQM **approved** a one-year extension for the Task Group on Metrology for Li-ion Batteries.
6) The CCQM **approved** a task group on gene delivery systems.
7) The CCQM **approved** a task group on digitalization (CCQM-DDTG) for a duration of 3 years.
8) **Action:** Dr Wielgosz will contact relevant members to organize a workshop on “omics”.
9) **Action:** Dr Winchester and Dr Shard will work together to propose a system for improved coordination of particle related studies across CCQM WGs.
10) **Action:** IRWG to draft a document outlining required resources to develop a database and provide a draft to BIPM Chemistry Department by 30 September 2025 for consideration.
11) **Action:** SAWG will form a TG to work on graphene and communicate findings to CCEM.
12) **Action:** BIPM to follow up with NAWG Chair regarding addition of nucleic acid calibrators to the BIPM Programme.
13) The CCQM **approved** the *mise-en-pratique* for the *ad hoc* WG on the mole.
14) The CCQM **approved** the proposed comparison studies in CCQM/2025-05.

EAWG	pH of a calcium hydroxide buffer (KC)
	Conductivity of 0.05 and 5 S/m KCl solution (KC)
GAWG	Sulfurous compounds in methane (KC)
	5 µmol mol^{-1} SF_6 in nitrogen (KC)
	Carbon Capture Utilization and Storage (KC)
	Ambient level NO in nitrogen (KC)
	CO_2 Scales (KC)
CAWG	In silico quantification of number of spheroids per image area (3D) (P)
	Sub-micron particle number concentration (P)
	Absolute count and subset quantification/ratio determination for T-cell subsets (P)
	Quantification of *E. coli* in drinking water (KC)
SAWG	Quantitative analysis of PtNi alloy films (KC)
	Relative mass fraction of polymers in thin film miscible blends (P)
PAWG	Calibration material for quantification of pathogen related proteins (P)

IAWG/EAWG	Water mass fraction measurements in crystallohydrates (KC)
IAWG	Arsenic speciation in foods (KC) Preparation of arsenic calibration solution (KC) Elements in metal alloy (KC)
OAWG	Multi-component non-polar pesticides in organic solution (KC) Fat-soluble vitamins in infant formula (KC)
NAWG	Copy number concentration and variant allele frequency (KC) Amount concentration of RNA fragment (KC)

15) **Action:** Dr Swart to draft terms of reference for proposed TG to work on shipment issues.
16) The CCQM **approved** the proposed workshop on re-review of CMCs and CMCs not supported by comparisons.

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