


CCQM President's Report

27th CGPM (2022)



Working together to
promote and advance
the global comparability
of measurement

Report by the President of the CCQM

Dr Sang-Ryoul Park President of the Consultative Committee for Amount of Substance: Metrology in Chemistry and Biology (*Comité consultatif pour la quantité de matière : métrologie en chimie et biologie*, CCQM) presented his report on the activities of the CCQM since the 26th meeting of the CGPM (2018).

CCQM Executive summary

Dr Sang-Ryoul Park assumed the Presidency of the CCQM at its 25th plenary meeting (11-12 April 2019), succeeding Dr Willie E. May, who had served as CCQM President since the 19th meeting of the CCQM (18-19 April 2013). Due to travel restrictions imposed by the Covid-19 pandemic, meetings of the CCQM and its WGs were held online in 2020, 2021 and 2022. The BIPM Headquarters organized and hosted 194 online meetings for the CCQM and its working groups, including the 26th and 27th plenary meetings of the CCQM.

The revision of the CCQM strategy document was initiated in the October 2019, with the strategy document and individual WG plans for 2021-2030 presented to the CCQM at its 26th meeting, and the approved versions published on 21 June 2021.

The CCQM had reacted quickly to support SARS-CoV-2 measurement responses at NMIs. Activity had included a pilot comparison, CCQM-P216, on Quantification of SARS-CoV-2 monoclonal antibody in solution (coordinated by NIM, NRC and BIPM) and another, CCQM P199b, on SARS-CoV-2 RNA copy number quantification, coordinated by LGC, NIMC, NIBSC, and NIST. Throughout 2020 and 2021, the CCQM organized a series of webinars, hosted by the BIPM, to engage expert stakeholders on discussion of actions required to ensure reliable measurement in response to the Covid-19 pandemic. The CCQM online Workshop on ‘A roadmap for metrology of infectious disease and future pandemic readiness’, was hosted by the BIPM and held on 5 to 7 October 2021, and resulted in the publication of the ‘*CCQM roadmap to metrology readiness for infectious disease pandemic response*’ on 5 September 2022. The implementations of the recommendations of the report will be overseen by a CCQM Task Group over the next 15 months, and include the development and implementation of ‘fire drill’ comparisons, to support rapid deployment of equivalent reference materials world-wide for any future event, and the development of e-learning modules.

The CCQM strategy identified stakeholder engagement as a key tool in promoting the activities and impact of the CCQM, and provided for a more structured approach to promote stakeholder engagement, including the use of workshops and webinars as well as Task Groups. The CCQM recommendation, in 2020, for a new value for the absorption cross-section of ozone, resulted in the formation of a Task Group for change implementation within the CCQM’s Gas Analysis WG and is actively working with all stakeholders to achieve an organized transition to the new reference value. In 2021, a Task group on Greenhouse Gas Scale Comparisons was established also in the CCQM’s Gas Analysis WG to develop protocols and guidance on CO₂ in air standards to meet the needs of the greenhouse gas emissions monitoring community. Following the 2022 CCQM workshop on Microplastic Measurements and Standards, a Task Group was formed to develop proposals for a programme of activities in consultation with stakeholders that could be progressed within the CCQM.

The comparisons organized by the CCQM to support the 6 300 calibration and measurements capabilities in the chemistry/biology field continued throughout the period, with 50 new comparisons within the period and publication of 47 final reports of comparisons.

The CCQM has been organizing a series of online workshops with the goal of engaging stakeholders to understand and define measurement challenges within new emerging areas including: Microplastic Measurements and Standards; Particle Metrology;

Metrology for Viral systems as metrology tools; Use of Mass Spectrometry in Radionuclide Metrology (with CCRI); The metrology of quantities which can be counted (with CCU).

Scope of the CCQM

The CCQM is responsible for developing, improving and documenting the equivalence of national standards (certified reference materials and reference methods) for chemical and biological measurements. It advises the CIPM on matters related to chemical and biological measurements including advice on the BIPM scientific programme activities.

The responsibilities of the CCQM are:

- a. to establish global comparability of measurement results through promoting traceability to the SI, and where traceability to the SI is not yet feasible, to other internationally agreed references;
- b. to contribute to the establishment of a globally recognized system of national measurement standards, methods and facilities for chemical and biological measurements;
- c. to contribute to the implementation and maintenance of the CIPM MRA with respect to chemical and biological measurements;
- d. to review and advise the CIPM on the uncertainties of the BIPM's calibration and measurement services as published on the BIPM website;
- e. to act as a forum for the exchange of information about the research and measurement service delivery programmes and other technical activities of the CC members and observers, thereby creating new opportunities for collaboration.

Strategy

The CCQM Strategy for the period 2021-2030 was published on 21 June 2021 and accompanied by descriptions of activities foreseen within the CCQM's technical working groups for the period. The document sets out the strategy to be followed by the CCQM in the period 2021-2030 to deliver its mission of advancing the global comparability of chemical and biological measurement standards and capabilities, and thereby enabling Member States and Associates to make measurements with confidence. In so doing, measurement science will also be progressed, and stakeholder engagement strengthened. In developing its strategy, the CCQM expert groups have identified nine key sectors that are expected to influence and drive the development of National Metrology Institutes' (NMI) and Designated Institutes' (DI) services within the 2021-2030 period and impact CCQM activities for achieving global comparability of chemical and biological measurements. Scientific, economic and social challenges, which can be tackled through metrology at the CCQM level, are described for the following sectors: Environment and Climate; Healthcare and Life Sciences; Food safety, trade and authenticity; Energy; Legal Metrology; Fundamental metrology and support of the SI; Forensic Sciences and Anti-doping; Advanced Manufacturing; Biotechnology and Drug Discovery.

The CCQM has set seven strategic aims to be progressed in the 2021-2030 period, notably: to contribute to the resolution of global challenges; to promote the uptake of metrologically traceable chemical and biological measurements; to progress the state of the art of chemical and biological measurement science; to improve efficiency and efficacy of the global system of comparisons for chemical and biological measurement standards it conducts; to continue the evolution of Calibration and Measurement Capabilities (CMCs) to meet stakeholders needs; to support the development of capabilities at NMIs and DIs with emerging activities; to maintain organizational vitality, regularly review and, if required, update the CCQM structure for it to be able to undertake its mission.

The strategy foresees contributions to progressing the state of the art in measurement science across all nine technical science areas covered by the Committee including Organic, Inorganic, Gas, Isotope Ratio, Surface, Electrochemical, Protein, Nucleic Acid and Cell analysis areas. Thirty-three activities have been identified where progress is expected, ranging from support for the development of new greenhouse gas, isotope ratio and microplastic standards, to the development of reference measurement systems for biomarkers, surface chemical composition, RNA quantification, food authentication, and cell counting as examples.

A more structured approach to stakeholder engagement is foreseen in the new strategy and considered as a key tool in promoting the activities and impact of the CCQM and of the Chemical and Biological Metrology community in general. A mid- and long-term plan for stakeholder engagement will be developed, including possible extension of the CCQM Liaison Membership, to better represent the expanded technical coverage of the committee, extended collaborations with other Consultative

Committees and sector specific fora established by the CIPM, and further use of task and focus groups to deliver the CCQM mission.

A core capability/comparison strategy will be continued with the aim of not increasing overall resources required for comparisons for the 71 institutes world-wide maintaining approximately 6 300 CMCs in the chemistry/biology field. Models for broad claim CMCs will continue to be developed, facilitating broader uptake of these, whilst meeting stakeholder needs, and potentially reducing the resources required to review and maintain CMC database entries.

Strong interaction will be maintained between the CCQM and RMOs, with continued coordination of linked, satellite and supplementary comparisons, and increased focus on capacity building and knowledge transfer including the initiation of mentoring programmes for NMIs coordinating comparisons for the first time.

The implementation of the strategy is supported by the BIPM Chemistry Department providing the CCQM Executive Secretary Role, coordination of comparisons in technical areas prioritized by the CCQM, laboratory-based knowledge transfer programmes for National Metrology Institutes with emerging metrology systems, the JCTLM database and support for engagement with stakeholder communities.

Activities and achievements since the last meeting of the CGPM

Change in CCQM Leadership, operations and meetings

Dr Sang-Ryoul Park assumed the Presidency of CCQM at its 25th plenary meeting (11-12 April 2019), succeeding Dr Willie E. May, who had served as CCQM President since the 19th meeting of the CCQM (18-19 April 2013). With the adoption of fixed terms for CCQM WG Chairs and deputy Chairs, new candidates were appointed to their positions during the 25th plenary meeting for the period 2019 to 2023.

The 25th plenary meeting was held at the BIPM Headquarters and was preceded by a CCQM Workshop on Advances in Metrology in Chemistry and Biology, coinciding with 25 years of CCQM activity, and was associated with a Focus Issue of *Metrologia* dedicated to 'Advances in Metrology in Chemistry and Biology'.

Due to travel restrictions imposed by the Covid-19 pandemic, meetings of the CCQM and its WGs were held online in 2020, 2021 and 2022, with the first onsite meeting of a working group held in October 2022. The BIPM Headquarters organized and hosted 194 online meetings for the CCQM and its working groups, including the 26th and 27th plenary meetings of the CCQM.

Publication of the CCQM 2021-2030 Strategy

The revision of the CCQM strategy document was initiated at the October 2019 meeting of the CCQM Strategic Planning Working Group. New vision and mission statements were developed and approved by the CCQM as well as seven strategic aims for the committee to achieve in the 2021-2030 period. All nine technical working groups initiated strategic reviews in 2020 of their activities and future plans for the forthcoming period. The strategy document and individual WG plans were presented to the CCQM at its 26th meeting, and after an additional period for comment, the approved documents were published on 21 June 2021.

CCQM response to the Covid-19 Pandemic

The importance of ensuring reliable diagnostic measurements as part of the response to the Covid-19 Pandemic led to the development of reference materials and methods at NMIs and DIs in 2020, both for SARS-CoV-2 viral RNA and SARS-CoV-2 monoclonal antibody quantification. In 2020 the CCQM also initiated two comparison studies to demonstrate the global consistency of such materials and methods, through its Nucleic Acid Analysis and Protein Analysis Working Groups. The comparison study on SARS-CoV-2 viral RNA quantification (CCQM-P199.b), coordinated by the LGC, NIM, NIST and the NIBSC, was completed in a very short period of six months from the initiation of the study. The comparison demonstrated the very good comparability that could be achieved with reverse transcription digital-PCR (dPCR) and a potential reference method,

with a very much smaller spread of results than for conventional laboratory-based methods and equivalence of results to non-PCR methods, demonstrating the potential accuracy of dPCR. The comparison on the quantification of SARS-CoV-2 monoclonal antibodies (CCQM-P216), coordinated by the NIM, NRC and BIPM, was completed and published in November 2021, providing the first CCQM comparison study on this size of protein structure and the level of comparability that could be achieved using quantification methods based on peptide fragment quantification following tryptic digest.

Throughout 2020 and 2021, the CCQM organized a series of webinars, hosted by the BIPM, to engage expert stakeholders in discussion of actions required to ensure reliable measurement in response to the Covid-19 pandemic. The webinars covered the issues of: performance of laboratories in proficiency testing schemes; performance and standards needs for molecular, antigen and mass spectrometric methods; performance and standardization of high throughput testing methods. The 26th meeting of the CCQM plenary meeting included a session of how NMI/DI activities would evolve to contribute to a robust infrastructure to enable readily available reliable measurements for infectious diseases in potential future pandemics. The CCQM online Workshop on ‘A roadmap for metrology of infectious disease and future pandemic readiness’, was hosted by the BIPM and held on 5 to 7 October 2021, with the goal to develop a roadmap for metrology to support measurements associated with infectious disease and future pandemic readiness, based on identifying and characterizing appropriate prognostic and diagnostic technologies, platforms and data management/integration, and recommending specific metrology interventions that could enable a more rapid response and enhance clinical outcome for a future pandemic. The workshop resulted in the publication of the ‘*CCQM roadmap to metrology readiness for infectious disease pandemic response*’ on 5 September 2022. The implementations of the recommendations of the report will be overseen by a CCQM Task Group over the next 15 months, and include the development and implementation of ‘fire drill’ comparisons, to support rapid deployment of equivalent reference materials world-wide in case of any future event, and the development of e-learning modules for those laboratories developing capabilities in this field.

Stakeholder Engagement

The CCQM strategy identified stakeholder engagement as a key tool in promoting the activities and impact of the CCQM, and provided for a more structured approach to promote stakeholder engagement. To carry this forward, the strategy proposed the establishment of a new CCQM Task Group to develop mid- and long-term plans for stakeholder engagement, including:

- Extension of CCQM Liaison membership to represent the expanded technical coverage
- Interaction with other Consultative committees
- Strong participation in sector-specific fora established by the CIPM
- Further use of Task Groups to deliver the CCQM mission.

The Task Group was established during the 26th CCQM meeting, and produced eight recommendations including the use of workshops and webinars as well as Task Groups within the CCQM to engage stakeholders.

The creation of Task Groups at the CCQM and CCQM working group level to achieve well defined goals with stakeholder communities has progressed substantially in the period. In 2020, the CCQM recommended a new value for the absorption cross-section of ozone, which would underpin world-wide ozone monitoring, following a CCQM workshop on the topic. A Task Group for the implementation of the new Ozone Cross-section was established within the CCQM’s Gas Analysis WG and is actively working with all stakeholders to achieve an organized transition to the new reference value. In 2021, a Task group on Greenhouse Gas Scale Comparisons was established also in the CCQM’s Gas Analysis WG to develop protocols and guidance on CO₂ in air standards to meet the needs of the greenhouse gas emissions monitoring community. Following the 2022 CCQM workshop on Microplastic Measurements and Standards, the CCQM approved the formation of Task Group to develop proposals for a programme of activities in consultation with stakeholders that could be progressed within the CCQM.

Metrology for Climate and the Environment

At its 27th meeting, the CCQM initiated the practice of including a sectoral focus session in its meetings, starting with Environment and Climate Sector. Six of the CCQM technical Working Groups had identified in the CCQM 2021-2030 strategy document that their activities supported this sector and presented summaries of these. Relevant activities were submitted to the BIPM-WMO Workshop on Metrology for Climate Action held in September 2022, as well as contributions that would be relevant to the newly established CIPM Sector Task Group on Environment and Climate.

Support for CIPM-MRA activities

The comparisons organized by the CCQM to support the 6 300 calibration and measurements capabilities in the chemistry/biology field continued throughout the period. Despite disruptions to comparisons schedules due to the Covid-19 Pandemic and changes in the geopolitical situation, the majority of planned comparisons could be initiated and completed. The CCQM initiated 50 new comparisons within the period and also published 47 final reports of comparisons.

In its 26th meeting, the CCQM approved the formation of a CCQM Task Group to update guidance on KCRV estimation. The task group was charged with updating the document CCQM/13-22, developed in 2013, for the ‘estimation of a consensus KCRV and associated Degrees of Equivalence’, taking into account new developments and approaches including dealing with the concept of ‘dark uncertainty’. The task group is expected to produce an updated draft at the end of 2022.

Metrology for Health

The CCQM contributed to the 2021 theme for world metrology on ‘Measurements for Health’, by contributing to the JCTLM-led initiative to launch a series of online videos explaining the role of standardization and metrology and the importance of metrological traceability to the field.

Addressing New Measurement Challenges

The CCQM has been organizing a series of online workshops with the goal of engaging stakeholders to understand and define measurement challenges within new emerging areas and then develop proposals for activities that can be progressed with the CCQM to address these. The CCQM workshops planned so far were: Microplastic Measurements and Standards (5-6 April 2022); Particle Metrology (25-27 October 2022); Metrology for Viral systems as metrology tools (24-27 January 2023). In addition joint workshops with other Consultative Committees have also been planned, notably: CCRI-CCQM Workshop on the Use of Mass Spectrometry in Radionuclide Metrology: Opportunities and Challenges (14 to 16 February 2023); CCU/CCQM Workshop on “The metrology of quantities which can be counted” (28 to 30 March 2023).

Support from Programmes at the BIPM Headquarters

The Chemical Metrology Department and Programmes at the BIPM Headquarters have continued to support CCQM activities as foreseen in the 2017-2026 CCQM Strategy, with the planned support activities updated in the 2021-2023 CCQM strategy document. In addition to supporting the CCQM comparison programme through coordination of comparisons for the Gas, Isotope Ratio, Organic and Protein Working Groups, the Department has supported the development of capabilities at NMIs and DIs with emerging activities through the provision of knowledge transfer programmes, which were converted to online e-learning modules to adapt to the restrictions imposed by the pandemic. The transition to exclusively online meetings for a period of almost 3 years, was facilitated by the support of the Department that organized and hosted the 194 online CCQM meetings in the period. The eight online CCQM workshops in the period have also been hosted by the BIPM, and the Department is supporting the three newly established CCQM Task Groups both at technical and organizational level.

CCQM Data

CCQM set up in 1993

President: S.-R. Park

Membership:

List of CCQM members and observers:

Meetings since the 26th CGPM meeting:

Full reports of the CCQM meetings:

Executive Secretary: R.I. Wielgosz

24 members, six liaisons and 13 observers

<https://www.bipm.org/en/committees/cc/ccqm/members>

11-12 April 2019, 26-28 April 2021, 27-29 April 2022

<https://www.bipm.org/en/committees/cc/ccqm/publications>

Eleven Working Groups:

<https://www.bipm.org/en/committees/cc/ccqm/working-groups.html>

- Cell Analysis (CCQM-CAWG)
- Electrochemical Analysis (CCQM-EAWG)
- Gas Analysis (CCQM-GAWG)
- Inorganic Analysis (CCQM-IAWG)
- Isotope Ratios (CCQM-IRWG)
- Key Comparisons and CMC Quality (CCQM-KCWG)
- Nucleic Acid Analysis (CCQM-NAWG)
- Organic Analysis (CCQM-OAWG)
- Protein Analysis (CCQM-PAWG)
- Strategic Planning (CCQM-SPWG)
- Surface Analysis (CCQM-SAWG)

One *ad hoc* Working Group:

- *ad hoc* Working Group on the Mole (CCQM-AH-WG-MOLE)

CCQM Comparison activity	Completed/ In progress	Planned
CCQM key comparisons	172	12 per year
BIPM ongoing comparisons	1	6
CC pilot studies	134	4 to 5 per year
CMCs	6 288 CMCs in 67 service categories registered in the KCDB	