Annual Review 2024

Thousands of decisions that affect our everyday lives are based on measurements.

To be able to rely on these decisions, there must be confidence in the measurements themselves.

Department for Science, Innovation & Technology

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Executive Summary

At the National Measurement Laboratory (NML) at LGC we continue to lead advancements in chemical and biological metrology (measurement science), driving accuracy, innovation, and global standardisation. As a centre of excellence, we work closely with national and international partners to ensure the highest standards underpin advancements in industry, healthcare, and environmental science.

In 2024, we remain at the forefront of diagnostic metrology, supporting pandemic preparedness through national and international collaborations. Our latest carbon isotope ratio measurement of VPDB set a new benchmark, recognised by the CIAAW as the most precise ever recorded—a tenfold improvement over previous standards. We are supporting emerging fields such as engineering biology establishing metrological tools, methods, materials and standards to support confidence in engineering biology processes. And we continue to strengthen our work with partners across the UK to maximise expertise and generate the best environment to support and encourage innovation, improving chemical and biological measurements for the benefit of the public.

The NML plays a critical role in shaping future advancements. Our commitment to excellence and collaboration enables progress across scientific disciplines, ensuring measurement science remains at the heart of innovation, regulation, and global competitiveness. The opening of our new Guildford site in 2025 will mark a significant milestone in our mission. This state-of-the-art facility will provide an enhanced environment for scientific innovation, fostering world-class research and attracting top talent.

As we look back on the past year, we're grateful for our team's dedication and the support of our partners. Thank you for being part of our journey.

Julian Braybrook

Director, National Measurement Laboratory

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NML at a glance

We are the UK's Designated Institute for chemical and biological measurement and support the work of the Government Chemist

We are sponsored by the Department for Science, Innovation and Technology (DSIT) as part of the UK National Measurement System

We ensure trust and confidence by providing access to the highest quality chemical and biological measurements in the UK to support government and industry needs

We work with different organisations from across industry, academia, regulators, government and healthcare

Our numbers

38 PEER-REVIEWED PUBLICATIONS

2 NEW ISO ACCREDITATION

120 REFERENCE MATERIALS

21 CONTRIBUTIONS TO ISO STANDARDS

Our locations

Join the measurement conversation:

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We are setting the future strategic direction internationally in the chemical and biological measurement fields

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We work globally to standardise measurement science

The NML maintains a leading role within the International Committee for Weights and Measures (CIPM), the Mutual Recognition framework through which National Metrology Institutes (NMIs) demonstrate their international equivalence.

We provide active support for 8 (out of 12) of the Consultative Committee for Amount of Substance (CCQM) Working Groups (WGs). We hold the Chairs for Nucleic Acid Analysis (2015-) and Cell Analysis (2019-) WGs.

We Chair the Task Groups on:

- Infectious Disease Diagnostics and Metrology for Pandemic Preparedness
- Guidance for the Estimation of a Consensus KCRV
- Terms, Quantities and Units for Bioanalytical Measurement (CCQM-TG-TQUB)

We hold the Vice chair position in the Task Group on Advances in Measurement Science

We are also members of the following Task Groups: Nano and Microplastics Measurements and Standards; Food Measurements; Particle Metrology; Clinical/ Toxicology sector.

19 CCQM STUDIES

6 AS STUDY LEAD

Demonstrating expertise in microparticle quantification

A recent international measurement study on polystyrene particles (CCQM P222) focused on evaluating the capability of international measurement institutes (NMIs/DIs) to accurately quantify microparticle number concentration (5 µm size). We participated in this study with two independent particle counting techniques: Optical Particle Analyser (OPA) and single particle ICP-MS (spICP-MS) as well as using the flow cytometry counting technique. We delivered excellent results, demonstrating our capability to accurately quantify number concentration of microparticles.

International traceability of chemical measurements: Eurachem

We play a key role in Eurachem activities through supporting the UK's national representatives (in conjunction with RSC). We are actively involved in all aspects of the network's activities through membership of the Executive Committee and chairing the Measurement Uncertainty & Traceability and Education & Training Working Groups.

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UK’s mission for accuracy: standardising global infectious disease diagnostics

Since their importance was identified in the management of the COVID-19 pandemic, it is now widely accepted that better prioritisation of early diagnostic testing and earlier access to more robust tests can reduce the spread of disease and protect public health.

We have continued driving our international leadership in the diagnostic space, supporting accuracy in the rapid production of test solutions for pandemic response.

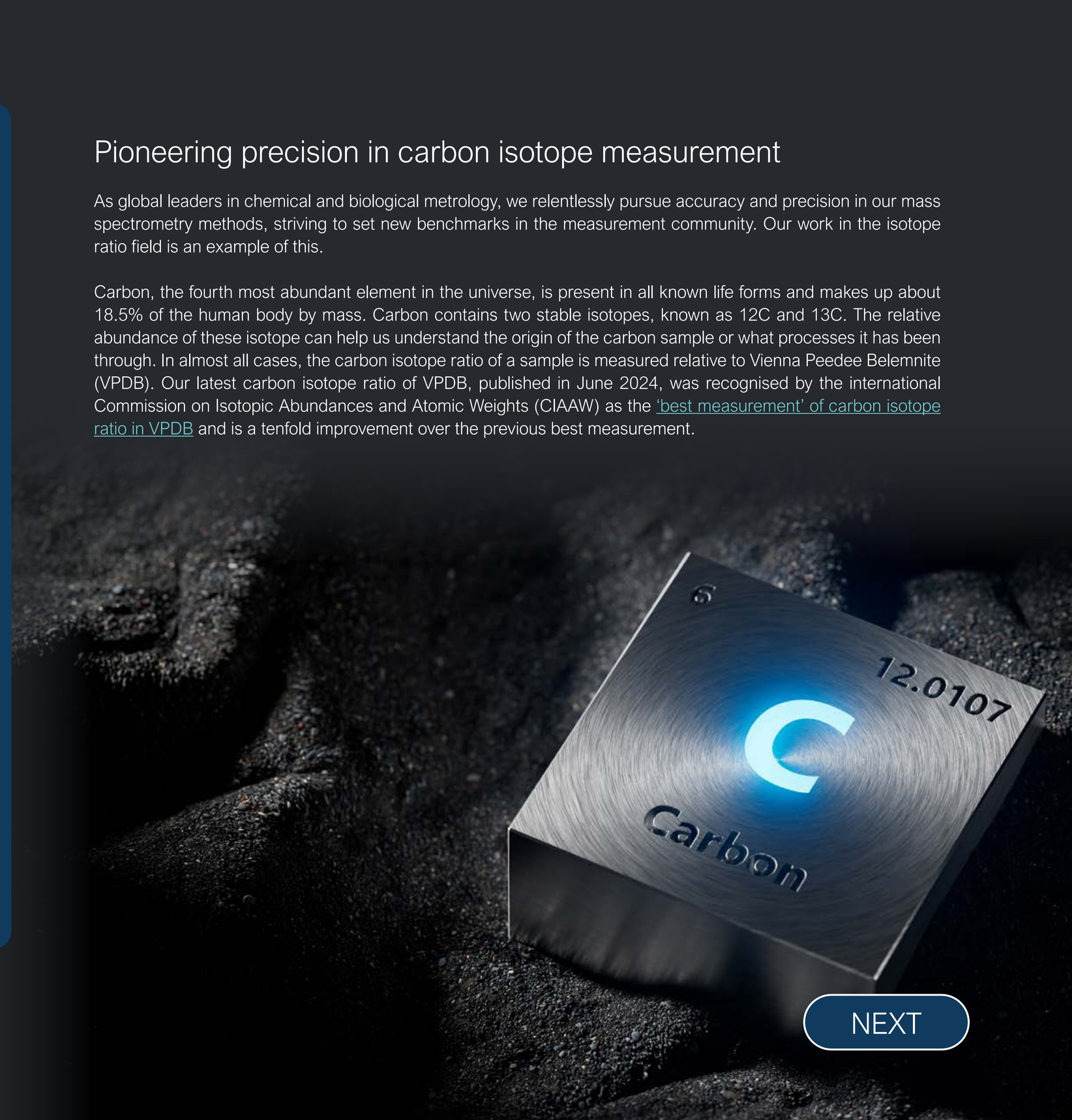
We are working with the UK government, the World Health Organisation, and the International Pandemic Preparedness Secretariat (100-day Mission), among a wide network of stakeholders, to ensure the most accurate tests are available at the beginning of a potential outbreak, allowing nations to be better prepared to stop it in its tracks.

Working closely with UKHSA we have led an international trial to develop support for test capacity using avian influenza (bird flu) as a simulated example. The outcome of this activity enabled the UKHSA Respiratory Virus Unit to perform assay verification, determine limits of detection of this influenza strain, and distribute to other UKHSA regional laboratories for analytical testing, ensuring preparedness should a future incident occur. The international trial demonstrated how high accuracy quantification of prototype reference materials could support the diagnostic test manufacturers and clinical laboratories to ensure test reliability in the face of a new biosecurity threat.

Pioneering precision in carbon isotope measurement

As global leaders in chemical and biological metrology, we relentlessly pursue accuracy and precision in our mass spectrometry methods, striving to set new benchmarks in the measurement community. Our work in the isotope ratio field is an example of this.

Carbon, the fourth most abundant element in the universe, is present in all known life forms and makes up about 18.5% of the human body by mass. Carbon contains two stable isotopes, known as 12C and 13C. The relative abundance of these isotope can help us understand the origin of the carbon sample or what processes it has been through. In almost all cases, the carbon isotope ratio of a sample is measured relative to Vienna Peedee Belemnite (VPDB). Our latest carbon isotope ratio of VPDB, published in June 2024, was recognised by the international Commission on Isotopic Abundances and Atomic Weights (CIAAW) as the ‘best measurement’ of carbon isotope ratio in VPDB and is a tenfold improvement over the previous best measurement.



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European projects

We actively participate in European-wide initiatives. Working collaboratively with the European metrology community under the Horizon Europe Partnership on Metrology (METPART), we deliver on challenges including health and the environment, and underpin innovation in industry.

This year we secured new projects that address issues such as the increased strain on Europe's healthcare systems, complex diseases and food safety.

Metrology for genomic profiling; early cancer detection and precision medicine (GenomeMET)

Cancer care is being transformed by advances in genomics, driven by technologies such as Next Generation Sequencing (NGS), enabling earlier and more accurate diagnosis, guiding therapy selection and driving development of targeted therapies (precision medicine). Although this will improve patient outcomes and support health system effectiveness, the quality and comparability of genomic profiling currently varies significantly, and development of standards and metrological means to support the field are in their infancy.

Through GenomeMET, we are developing the measurements and standards needed. This includes developing traceable methods for reliably assessing quality markers (critical quality attributes) across different steps of the genomic profiling process, developing reference measurement procedures to quantify variants in key cancer genes (e.g. PIK3CA), and supporting the design and development of new quality assurance (EQA) schemes to accommodate emerging tests, such as liquid biopsies, through development and production of appropriately characterised materials and prototype samples.

Building on the expertise developed through is work, we are inputting into a new international standard on requirements for cancer gene panel sequencing (ISO/AWI 25725) which will support better measurements across medical laboratories, molecular pathology laboratories and molecular genetic laboratories.

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Metrology for food safety in the circular economy (ScreenFood)

As the food industry shifts towards sustainability, ensuring consumer safety remains critical- especially with increased use of recycled and eco-friendly packaging. Contaminants migrating from packaging into food presents challenges, yet there are gaps in the provision of standardised methods and certified reference materials to address them.

Through ScreenFood, we are working with partners from other metrology institutes, industry, official laboratories and research institutes to develop analytical strategies and reference materials to support food and food-packaging industries to provide safe and sustainable products, compliant with legislation.

We coordinated the selection, review and distribution of selected food contact materials with varying compositions (including PET, polystyrene, polypropylene and paper based materials) that were distributed to the consortia for analysis. Additionally, we designed and are implementing an interlaboratory study to demonstrate laboratory capabilities for novel screening methods of forever chemicals. This work, delivered in collaboration with our international network of stakeholders from analysis laboratories, academia and industry will support the development of harmonised standards and novel methods to detect and quantify contaminants.

Metrology for protein precision; advancing structural characterisation to empower diagnostics and therapeutics (ProMet)

Accurate measurement and characterisation of proteins are essential for advancing diagnostics, biomarker discovery, and biopharmaceutical development. As diseases become more complex and precision medicine grows in demand, reliable and standardised protein analysis tools are crucial. However, proteins are dynamic and heterogeneous biomolecules and understanding and unravelling protein structures, their interactions, and their relationship to biological function is critical for accurate and comparable protein measurements.

Through ProMet, we are joining efforts with experts from other metrology institutes, and proteomics, structural biology and molecular biology communities, to work on developing a metrology framework and associated guidelines to support improved protein measurements.

Within the project, we will lead on developing and validating protocols for protein structural characterisation using a variety of advanced techniques (Hydrogen Deuterium Exchange Mass Spectrometry, native mass spectrometry, and crosslinking). These protocols will provide guidance for distinguishing protein structures (e.g. isoforms, post-translational modifications), with recommendations on quantification, traceability, and measurement uncertainty estimation to ensure accurate and reproducible results across different applications. This will be particularly important for personalised diagnostics and treatments, which require precise and accurate protein measurements.

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We provide a unique function for the UK to ensure comparability and facilitate trade

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Core capabilities

Our high-end purity and calibration measurement capabilities are critical for ensuring the resilience of the UK measurement infrastructure, providing accuracy and reliability of measurements, vital for ensuring quality and safety of products and helping businesses maintain their global competitiveness through compliance with regulations and international standards.

To continue addressing evolving chemical and biological measurement needs, we have implemented a significant upgrade to some of our core analytical platforms, thus strategically enhancing our capabilities for analysing ever more complex and smaller quantity samples with increasing accuracy and precision.

This investment, secured through consecutive successful applications for DSIT infrastructure funding, has led to:

- Enhanced qNMR capabilities with increased sensitivity and automation, delivering cost-effective characterisation of reference standards and calibration services for industry and regulators.
- Further strategic expansion into biomolecular analysis, underpinning critical research areas inclusive of synthetic biology (engineering biology) in food, diagnostics and advanced therapeutics.

Using these recently extended capabilities, we are working with UKHSA to develop a complementary technology approach for strengthening the UK nucleic acid synthesis capability for diagnostic control materials. This work will limit reliance on international providers, increasing the UK government's resilience in the face of novel biological threats, ultimately improving biosecurity.

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Reference materials

Reference materials are the cornerstone of accurate and traceable measurements – they are measurement standards which can be used for many purposes including validation of analytical methods, establishing metrological traceability and to support quality control. We maintain a dynamic portfolio of around 120 materials covering high purity standards, carbon isotope ratios, food, environmental and clinical materials, and alcohol standards.

This year we released 2 new materials and 6 replacement materials to assist in the reliable quantification of immunosuppressants in clinical samples to support alcohol determinations related to duty payments in the food and beverage industry, to help ensure the quality of public water supplies, to support measurements of heavy metals in food, and to calibrate widespread measurements of melting temperature.

Replacement

LGC2408	**2-chloroanthraquinone – melting temperature**
LGC5404	**Reference spirit 5 % ABV**
LGC5412	**Reference Spirit 40 % ABV**
LGC6012	**Hard drinking water – anions**
LGC6013	**Soft drinking water – anions**
LGC7161	**Tomato paste – metals**

New

LGC5014	**Beer - 3.7% ABV**
LGC8272	**Human blood - Tacrolimus (incurred)**

View our reference materials catalogues

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Our expertise and advice is relied on by government to underpin standards, develop regulation and support innovation, facilitating productivity and growth

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As part of the UK National Measurement System, we support the development and maintenance of world-leading and internationally recognised measurement capability, standards and practices to; ensure confidence and trust in measurements across the UK, underpin key policies, regulations and operational requirements across government, provide independent expert advice to the public and private sectors, and support creation and adoption of new technology.

Documentary Standards

Recent standards activities have included work in the areas of biotechnology, nanotechnology, in vitro diagnostics, engineering biology and reference materials, and support the Sustainable Development Goals of good health, economic growth and industry and innovation. The technical work and pre-determined timeframe for producing a documentary standard typically spans a period of 2 to 3 years.

Using our biological measurement expertise, we are leading on the development of a new standard for sequencing of microbes in the management of infectious disease (ISO 8219) to support the in vitro diagnostics industry and have been actively involved in the development of new standards for the sequencing of human DNA and RNA for diagnostic purposes (ISO 25379-1, ISO 25379-2).

In addition to developing new standards, we help maintain and update standards to ensure they continue to be fit-for-purpose, including leading on the review of a nanotechnology standard to reliably detect, characterise and quantify nano-objects using advanced mass spectrometry (spICP-MS) to support instrument manufacturers, industry and researchers working in this field.

21 **CONTRIBUTIONS TO ISO STANDARDS**

UK leadership for biotechnology standards

This year we hosted, together with The British Standards Institution and the International Organization for Standardization (ISO), the annual meeting of the ISO Committee for Biotechnology (TC/276) in Glasgow. This was the first time the Plenary has been held in the UK. The NML holds the Chair for the UK national mirror committee (under BSI) and leads on and contributes to standards development within ISO TC/276. In particular, we are leading on the development of a new standard for gene expression profiling of bioengineered systems (ISO 12833) and co-leading on a suite of new standards for gene delivery systems (ISO 16921-1, ISO 16921-2 and ISO 16921-3) to support a wide range of biotechnology and engineering biology applications.

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De-risking engineering biology

With ongoing support from the BBSRC to provide further metrology training within research institutes and across industry, we have been active in engaging with stakeholders across the sector to ensure confidence in research. For example, we are involved in the CYBER Mission Award, supported by the UKRI Technology Missions Fund and the BBSRC, to develop the foundational multidisciplinary tools needed to de-risk environmentally focused engineering biology and ultimately support its future deployment into real-world ecosystems.

Metrology for engineering biology

Engineering biology has the potential to offer solutions to a range of societal challenges, including agriculture and food, biomedicines, clean growth and the environment. Standards and metrology (measurement science) are critical for creating more reliable engineering biology products, services, and production processes, helping to de-risk innovation and facilitate translation into industry. Improved measurement confidence helps to ensure safety and increase quality. This year, we led on establishing metrological tools, methods, materials and standards to support confidence in engineering biology processes.

We completed delivery of a programme of measurement science (metrology) skills training, funded by the BBSRC, to early career researchers at 15 BBSRC funded Engineering Biology Centres of Excellence across the UK. The programme covered the fundamentals of metrology as well as its practical application using different technologies (e.g. immunoassays, flow cytometry, qPCR techniques).

As a follow-on from the training programme, we submitted a proposal for an international standard to support standardisation of measurements in engineering biology on behalf of the UK. The standard (Biotechnology- Considerations for RNA quantification methods for gene expression analysis of biological system) has been successful in review and is being taken forward for first draft through ISO TC/276 Biotechnology, demonstrating further UK leadership in this space.

Find out more about our work to support engineering biology

Biotechnology and Biological Sciences Research Council

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We work in partnership with our stakeholders to address current and future measurement challenges across the life sciences, green industries and food sectors

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Our strategic partnerships

Over the past year, our strategic partnerships have evolved into **engines of translation and impact**, paving the way for accelerated collaboration across the UK. We focused on building stronger local roots across the UK, leading to greater and more varied interactions within the academic, startup and local government regional ecosystems, where our different Centres are recognised as valued assets.

In an independent analysis of Leeds' research and innovation in health and care, commissioned by the West Yorkshire Combined Authority, our Northern Cell Metrology Laboratory (in partnership with the University of Leeds), was recognised as a 'novel epicentre of innovation in clinical diagnostics and medical technology to which Nexus community have access'.

The first startup incubated at our Centre at Strathclyde, Microplate DX, received the Barclays Entrepreneur Award for Innovation in Health & Life Sciences 2024 and continues to thrive at the Centre's laboratory.

To scale our Centres and deliver greater impact, we collaborate with national initiatives, providing metrology support for innovation in emerging research areas. This is exemplified by our role in formulating and subsequent participation in the board of the National Alternative Proteins Innovation Centre (NAPIC). Led by Professor Anwesha Sarkar at the University of Leeds, NAPIC is an innovation ecosystem with 150+ partners, shaping the UK's rapidly evolving alternative protein sector and serving as a trusted global knowledge hub.

New academic roles have been added to the Centres, supporting training for the next generation, and our academic collaborators have been successful in securing grants to support metrology-driven research. A successful British Heart Foundation grant is developing a low-cost and easy to use electrochemical detection platform for screening cardiac biomarkers at the point of need.

"NML's contribution to NAPIC from the beginning of its journey to the first partner engagement workshop report, where discussion groups focused on NAPIC's six key Innovation Challenges, underscores a collaborative approach to overcoming industry challenges, developing new metrics and standards to assess the environmental impact of alternative protein production and consumption, promoting sustainable practices throughout the value chain" - Professor Sarkar, Co-Director, NAPIC

We remain focused on growth for our existing Centres, while exploring new opportunities in other areas, such as metrology for pandemics preparedness, involving partners including The Pandemic Institute and the Liverpool School of Tropical Medicine, to embed metrology advances into real-world clinical interventions.

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Cross sector collaboration to standardise bioimaging technology

Understanding the concentration and distribution of elements within biological systems can provide insights for both disease research and therapeutic development. Elemental imbalances may signal illness, while assessing the ultimate location of element-containing novel therapeutics provides information on their efficacy and safety.

We use laser ablation inductively coupled mass spectrometry (LA-ICP-MS) technology to visualise the elemental distribution of biological tissues and cells. This bioimaging technique allows high resolution (micron level) analysis with minimum sample preparation or alteration. At the NML, we have been developing methods and calibration standards to quantify elemental distribution.

Leading international calibration of LA-ICP-MS bioimaging

We are co-ordinating an international comparison study between measurement institutes, with calibration standards (gelatin) prepared using 3D bioprinting technology. These standards have been extensively characterised in collaboration with the National Physical Laboratory and laser manufacturer Elemental Scientific Lasers. Alongside the international comparison, this material will be distributed to the wider community to be used for tuning and calibration of LA-ICP-MS bioimaging experiments.

Advancing novel therapeutics through academia collaboration

Our bioimaging capabilities are being applied to novel therapeutic research through successful collaborations with academic partners. With the University of Zaragoza, we are developing methods for accurate quantification of nanoparticle uptake in cells. In partnership with the University of Dundee and Alzheimer's Research UK, we are investigating the concentration of iron in mouse brain to explore the link between diabetes, iron dysregulation and Alzheimer's disease. An ongoing collaboration with the University of York is focused on analysing the concentration of key elements such as sodium in tumour tissues to better understand the development of tumours in different forms of cancer. Underpinned by sound measurement science, this work will provide confidence in the research delivering novel therapies to improve patient care.

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Healthcare Scientist Knowledge Transfer Partnership Programme

Our commitment to improving the UK measurement infrastructure for healthcare has naturally evolved into a strong partnership with the NHS, and to a partnership programme being established, managed by the NML. This unique initiative brings together healthcare partners from England, Scotland, Northern Ireland and Wales with the UK's National Measurement System (NMS) and the United Kingdom Accreditation Service (UKAS) to transfer knowledge, skills and expertise into clinical practice. Now in its fourth round, the programme fosters collaboration to unlock high-value innovations that are improving patient outcomes, increasing efficiency within the NHS and fuelling economic growth in life sciences.

Find out more about the Healthcare Scientist (HCS) Knowledge Transfer Partnership (KTP) Programme

Standardising molecular precision for acute myeloid leukaemia care

Measurable residual disease (MRD) testing allows the detection of extremely low levels of malignant cells remaining after cancer treatment. It can be used to predict which patients will relapse and which will maintain their remission. There are several exciting new treatments becoming available for patients with acute myeloid leukaemia (AML) but to assess the effectiveness of these treatments within clinical trials, highly accurate MRD testing is required which is comparable between laboratories.

We partnered with the External Quality Assurance (EQA) provider for Leucocyte Immunophenotyping (UK NEQAS LI), the Medicines and Healthcare Regulatory Agency (MHRA) and UKAS to support standardisation of molecular MRD testing for acute myeloid leukaemia. Working with leading clinical scientists and clinicians, molecular test and quality material manufacturers, and representatives of other AML standardisation initiatives, we identified standardisation needs and priorities and outlined potential standardisation solutions. The resultant recommendations, published as a Letter to the Editor in the journal Leukaemia, included the development of World Health Organisation International Standard reference materials for frequently tested for AML biomarkers.

This collaboration supports improvement of the accuracy and interlaboratory comparability of molecular MRD testing by embedding measurement traceability within EQA schemes, establishing better relationships between measurement science, EQA and healthcare providers, and ultimately leading to better patient care.

NML · Medicines & Healthcare products Regulatory Agency · NPL National Physical Laboratory · UKAS A world of confidence · HSC Health and Social Care · NHS · GIG CYMRU NHS WALES Addysg a Gwella Iechyd Cymru (AaGIC) Health Education and Improvement Wales (HEIW) · Scottish Government Riaghaltas na h-Alba

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Innovate UK Analysis for Innovators

We are a partner in the UKRI Innovate UK Analysis for Innovators programme. The programme provides companies with access to state-of-the-art measurement and analytical capabilities and focuses on solving measurement problems within existing businesses to improve competitiveness and productivity.

This year, we continued to explore numerous opportunities to enhance our relationships with industry and to offer measurement expertise to UK companies in the areas of biotechnology, medical diagnostics and purification. Three rounds of the programme (Round 10, 11 and 12) were launched this year and we are currently involved in 10 projects with UK companies.

Innovating safer solutions for nuclear decontamination

We collaborated with MDCO, a specialist chemicals company, as part of the UKRI Innovate UK Analysis for Innovators programme. The goal was to test MDCO's range of cleaning products, intended for decontamination activities at nuclear facilities, which significantly reduces radioactive contaminated waste materials compared to the traditional clean up method. We analysed the cleaning wipes to identify key elements and impurities, e.g. halogens, which could pose corrosion risks to the required long-term waste storage containers, e.g. steel drums, or environmental contamination. This partnership enabled MDCO to confidently market their cleaning products as environmentally friendly, contributing to safer and greener practices in the nuclear industry.

Find out more about the Innovate UK Analysis for Innovators programme

Revolutionising heart failure treatment with cutting-edge cell therapy innovations

Within our Northern Cell Metrology Hub in Leeds, part of our strategic partnership with the University of Leeds and Nexus, we have developed new technologies to tackle important challenges linked to regenerative therapy for heart failure.

Working with the SME HeartCells, as part of the UKRI InnovateUK Analysis for Innovators programme, we supported HeartCells to standardise and improve the assessment of the quality and potential productivity of novel cell formulations that are subsequently used in patients undergoing groundbreaking cell therapy. In addition to generating new intellectual property for HeartCells, the partnership also provided a big step towards the goal of getting regulatory approval from authorities such as the MHRA, generating a new validation report according to recognised international guidelines (International Council for Harmonisation (ICH)) to demonstrate the quality of novel medicines and therapeutics (ICH Q2 (R2)).

Based on this work, further collaborations between HeartCells and the NML are being explored to develop a novel tool to predict outcomes in heart failure patients receiving autologous cell therapy. This tool will help commercialise the cell product and shorten the path to market.

“The HeartCells Company is extremely pleased to have collaborated with NML on this project and are delighted with the outcome, which is a key component to the HeartCells plans for future clinical trial fundraising. HeartCells very much hopes to continue this relationship on future projects.” – Stephen James CEO HeartCells

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Our work makes a difference, helping to solve some of the biggest challenges of our time, protecting the public and improving quality of life

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Sustainability

Our world leading research also addresses some of the biggest environmental challenges of our time, including food authentication and sustainability, climate change, renewable resources and water pollution.

Supporting safe innovation and environmental sustainability with improved nanomaterial analysis

Nanomaterials (NMs) are widely used in wide range of consumer products like paints, electronics, cosmetics, and food to improve their properties. Given their rapid adoption, ensuring reliable detection and accurate quantification within the commercial product is essential to ensure consumer safety and support a product's regulatory compliance.

By exploring new methods of quantifying nanoparticles (particle-specific isotope dilution mass spectrometry (ICP-IDMS) techniques), we have achieved more reliable quantification of nanoparticles in simple and highly complex food matrices. Such methodology will be invaluable in the production of matrix reference materials for nanoparticle concentration, which are currently unavailable.

Nanomaterials have also emerged as potential environmental contaminants. Through PlasticTrace, a project funded under the European Partnership on Metrology, we are working with collaborators to systematically evaluate the applicability of currently available measurement methods for the characterisation of nanoplastics in drinking water and to develop reference materials.

This research contributes to the standardisation of nanomaterial measurement, supporting industry efforts to refine quality control and to innovate safely, leading to safer consumer products and improved environmental protection.

Recovering technology's most valuable elements with precise measurement

From smartphones to green energy initiatives, Technology Critical Elements (TCE) such as gallium, indium, and platinum, are essential yet difficult to replace. Recycling them from e-waste supports sustainability but presents a complex analytical challenge.

Through MetroCycleEU, a project funded under the European Metrology Programme for Innovation and Research (EMPIR), we are working with industry, academia and research institutes to improve the recovery of technology critical elements from e-waste. Through this project, we supported the development of sampling methods, chemical analysis, reference materials and tools (guidance, training and calculations) to support companies maximise their recycling efficiency.

By advancing recycling technology, MetroCycleEU supports the European Circular Economy Agenda and UN Sustainable Development Goals, helping to reduce waste and build a more sustainable and resilient future.

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Wellbeing

Our cutting-edge measurement science is transforming healthcare by enabling more accurate diagnostics, enhancing treatment precision, and driving innovations that improve quality of life across diverse medical fields.

Enhancing oral microbiome analysis for better health insights

The oral microbiome plays a crucial role in health, influencing conditions such as dental disease, diabetes, and cancer. However, current analysis methods often rely on simplified standards that don't accurately reflect the complexity of real-world oral microbiome samples and their saliva matrix. This can lead to incorrect results, affecting disease diagnosis and research.

Through the UKRI Innovate UK Analysis for Innovators programme, we partnered with Salient Labs Ltd to improve the accuracy of microbiome profiling. We analysed real-world saliva samples using digital PCR (dPCR) to quantify key microbes and compared these results to Salient's deep metagenomic shotgun profiling. The project also explored the impact of host DNA depletion, a process that removes human genomic materials to improve sequencing efficiency. Since human DNA can make up 98% of sequencing reads, it's removal could lead to cost savings of approximately £20 per sample while maintaining quality.

These advancements not only enhance oral microbiome analysis but could also benefit studies of other microbiomes with high levels of host DNA, improving the accuracy and affordability of microbiome research for broader medical applications.

Ensuring precision in cancer care

Quantification of the BCR::ABL1 fusion gene transcript (messenger RNA) is a critical factor in the management of patients with Chronic Myeloid Leukaemia (CML), following treatment with targeted inhibitors of the BCR::ABL1 protein (TKIs), or stem cell transplantation.

Following a successful project with UK NEQAS LI through the HCS KTP programme, we have continued a partnership with UK NEQAS LI to standardise molecular MRD testing for Chronic Myeloid Leukaemia (CML). Supported by our Chemical and Biological Metrology programme, we developed a candidate reference method for the CML biomarker, BCR::ABL1, which is the causative genetic mutation of this cancer and is monitored during MRD testing. The candidate reference method quantifies levels of BCR::ABL1 using reverse transcription-digital PCR (RT-dPCR), a single molecule counting approach of high precision. This method was applied to a set of EQA samples to compare the values measured by the reference method with those calculated based on a consensus approach from EQA participants' reported results.

This collaboration supports improvement of the accuracy and interlaboratory comparability of molecular MRD testing by embedding measurement traceability within EQA schemes, leading to better patient care as well as establishing relationships between measurement science, EQA and healthcare providers.

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Advancing neurodegenerative disease diagnosis

Neurodegenerative diseases like Parkinson's disease (PD) and Lewy body dementia are linked to the aggregation of α-synuclein, a protein that is increasingly used as a biomarker for diagnosis. However, current detection methods, including antibody-based immunoassays, can produce inconsistent results due to differences in antibody specificity and the lack of established analytical reference methods, making it challenging to compare results across studies.

By combining our protein metrology and purity capabilities (amino acid analysis (AAA) isotope dilution mass spectrometry (IDMS) approach and quantitative nuclear magnetic resonance (qNMR)), we developed a highly accurate reference measurement procedure for α-synuclein – which is traceable to the International System of Units (SI). This can be used to improve the accuracy of clinical methods used for the sensitive detection of α-synuclein in cerebrospinal fluid (CSF) from patients.

This breakthrough offers a more reliable way to measure α-synuclein, paving the way for standardised diagnostics and improved comparison across laboratories. Ultimately, these advancements could enhance early disease detection, support better treatment strategies, and contribute to global efforts to combat neurodegenerative conditions.

Read our publication A candidate reference measurement procedure for the quantification of α-synuclein in cerebrospinal fluid using an SI traceable primary calibrator and multiple reaction monitoring

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We transfer knowledge and skills to advance and equip a new generation of scientists

Analytical quality training programme

We empower laboratories worldwide with expert training in quality assurance, helping them meet accreditation and regulatory standards with confidence. Our courses cover essential topics like method validation, measurement uncertainty, and statistical analysis—equipping analytical scientists with the skills they need to excel.

With flexible training options available online and in-person, we offer scheduled programmes and tailored solutions for organisations. Our approach ensures lasting impact, with strong repeat engagement and consistently positive feedback from participants.

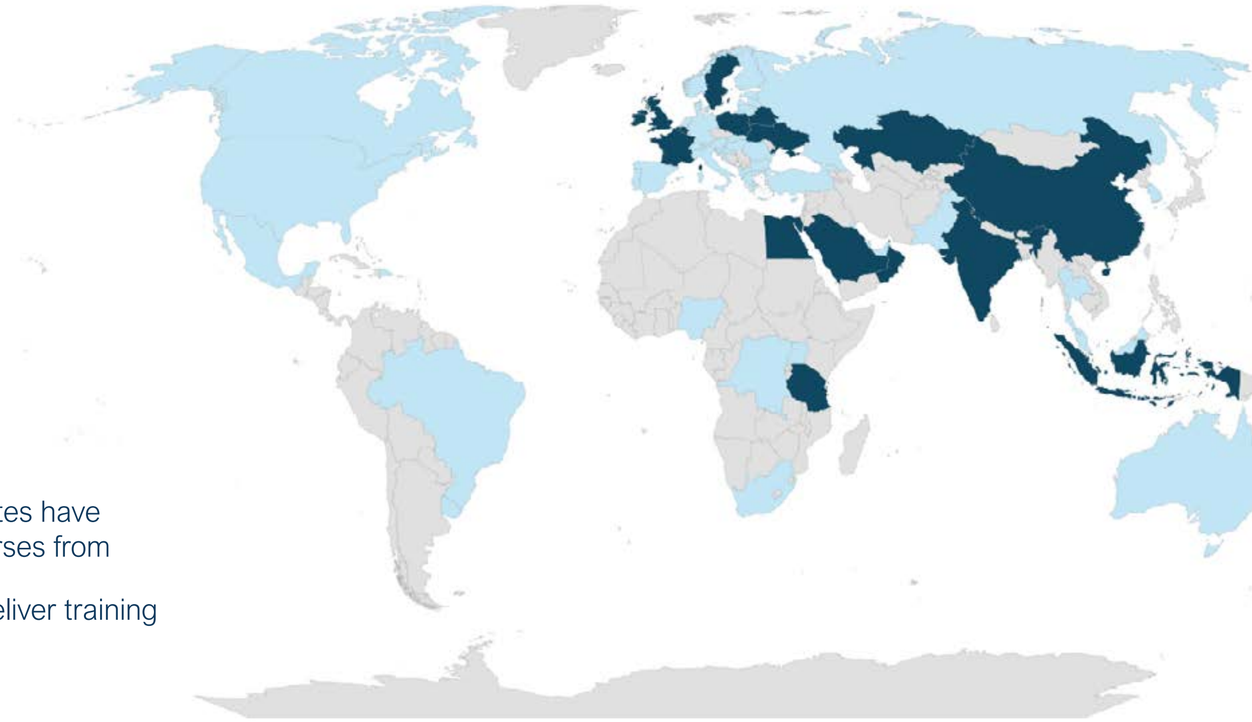
29
COURSES

315
DELEGATES TRAINED

64
ORGANISATIONS

OVER 95%
OF RESPONDENTS FEEL OUR TRAINING COURSES MEET THEIR EXPECTATIONS

25+ YEARS EXPERIENCE
DELIVERING TRAINING PROGRAMMES TO CLINICAL, ENVIRONMENT, PHARMACEUTICALS, CHEMICAL, FOOD AND BEVERAGES, FORENSICS, UTILITY SERVICES, ACADEMIC SECTORS



- Countries that delegates have attended training courses from
- Countries visited to deliver training

Details of all our training programmes are available at www.uknml.com/training

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07 | Our people

Our scientists are recognised nationally and internationally for their expertise. This is recognised in part through joint appointments with leading academic institutions, invitations onto committees, and awards.

Visiting academic roles

- **Harry Barraza** (Visiting Scholar, Queen's University Belfast)
- **Kharmen Billimoria** (Honorary Research Fellow, University of Warwick)
- **Julian Braybrook** (Visiting Professor, University of Surrey; Visiting Scholar, Queen's University Belfast)
- **Heidi Goenaga Infante** (Visiting Professor, University of Strathclyde; Honorary Senior Research Fellow, University of Liverpool)
- **Paul Hancock** (Visiting Scholar, Queen's University Belfast)
- **Jim Huggett** (Visiting Professor, University of Surrey)
- **Denise O'Sullivan** (Visiting Professor, University of Surrey)

Notable achievements

Kharmen Billimoria awarded 2024 European Rising Star for Plasma Spectrochemistry

Malcolm Burns invited to become an independent panel member for Defra Public Appointments

Cailean Clarkson appointed as vice chair for the CCQM Organic Analysis Working Group Task Group on Advances in Measurement Methods

Philip Dunn invited to participate in IAEA Technical Committee leading to formal definitions of various isotope delta scale

Carole Foy appointed as Chair of the BSI CH/212 (In Vitro Diagnostics) Standards Committee

Luise Luckau awarded Best Oral Presentation on "Progress on the standardisation of α-synuclein and neurofilament light chain biomarkers in neurodegenerative diseases" at at the 22nd National Congress of the GSCC-CB in collaboration with the IFCC Scientific Division (IFCC-SD)

Denise O'Sullivan appointed Chair of the IFCC Committee on Molecular Diagnostics in Infectious Diseases (C-MDID)

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Publication highlights

The quality and credibility of our science is demonstrated in part through our publications in peer reviewed journals. This year, our scientists published 38 peer review publications. Here is a short selection:

Bartczak, D., Cuello-Nuñez, S., Pálmai, M., Hill, S., Petrov, P., Varga, Z., Szalay, R. and Goenaga-Infante, H. Determination of the nanoscale silica mass fraction by AF4/ICP-MS with isotope dilution analysis using 29Si-enriched silica nanoparticles. https://doi.org/10.1021/acs.analchem.4c00021.

Billimoria, K., Andresen, E., Resch-Genger, U. and Goenaga-Infante, H. A strategy for quantitative imaging of lanthanide tags in A549 cells using the ratio of internal standard elements. https://doi.org/10.1021/acs.analchem.4c02763

Bourn, M., Daly, L., Gregory, S. and Rivera, J. Evaluation of conventional adherent cell enumeration methodologies alongside image-enhanced flow cytometry. https://doi.org/10.1051/bioconf/202412916012.

Dunn, P., Malinovsky, D., Ogrinc, N., Potočnik, D., Flierl, L., Olaf Rienitz, Paul, D. and Harro. Re-determination of R(13C/12C) for vienna peedee belemnite (VPDB). https://doi.org/10.1002/rcm.9773.

Falak, S., O'Sullivan, D.M., Cleveland, M.H., Cowen, S., Busby, E.J., Devonshire, A.S., Valiente, E., Jones, G.M., Kammel, M., Milavec, M., Vierbaum, L., Schellenberg, I., Zeichhardt, H., Kummrow, A., Vallone, P.M., Macdonald, R. and Huggett, J.F. The application of digital PCR as a reference measurement procedure to support the accuracy of quality assurance for infectious disease molecular diagnostic testing. https://doi.org/10.1093/clinchem/hvae187.

Huggett, J.F., O'Sullivan, D.M., Cowen, S., Cleveland, M.H., Davies, K., Harris, K., Moran-Gilad, J., Winter, A., Braybrook, J. and Messenger, M. Ensuring accuracy in the development and application of nucleic acid amplification tests (NAATs) for infectious disease. https://doi.org/10.1016/j.mam.2024.101275.

Kontogiannis, T., Braybrook, J., McElroy, C., Foy, C., Whale, A.S., Quaglia, M. and Smales, C.M. Characterization of AAV vectors: A review of analytical techniques and critical quality attributes. https://doi.org/10.1016/j.omtm.2024.101309.

Ojeda, D., Bartczak, D., Singh, M., Hancock, P. and Goenaga Infante, H. The potential of a multi-method platform centred on ICP-MS to provide new insights into the size-resolved quantification of TiO2 particles in food. https://doi.org/10.1039/d4ja00074a.

Zhang, L., Illes-Toth, E., Cryar, A., Drinkwater, G., Vagno, L.D., Pons, M.-L., Mateyka, J., McCullough, B., Achtar, E., Clarkson, C., Göschel, L., Körtvélyessy, P., Mussell, C., Hopley, C.J., Flöel, A., Hirtz, C., Lehmann, S. and Quaglia, M. A candidate reference measurement procedure for the quantification of α-synuclein in cerebrospinal fluid using an SI traceable primary calibrator and multiple reaction monitoring. https://doi.org/10.1039/d4an00634h.

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Contact us to access expertise in a range of chemical and biological measurement technologies and related topics such as analytical quality assurance, method validation, measurement uncertainty, reference materials and proficiency testing.

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