

RIDING THE

# WAVE OF PROGRESS

## Applied Sciences Group

Our innovative and technology-driven outlook has enabled us to stay agile to enhance our techniques and capabilities.





## KNOWLEDGE AND INNOVATION

We are constantly developing new capabilities and techniques to better serve our stakeholders.

### QUALITATIVE AND QUANTITATIVE ANALYSIS OF HYDROGEN PEROXIDE

Hydrogen peroxide ( $H_2O_2$ ) solution is commonly used as an antiseptic solution and can be easily purchased from pharmacies.  $H_2O_2$  solution with concentration of more than 20% weight in weight is regulated in Singapore.

We developed a workflow to screen for hydrogen peroxide using commercial test strips and Raman spectroscopy, and for quantitative analysis using titration methods adapted from the American Society for Testing and Materials. This workflow was successfully applied to real samples, demonstrating its feasibility to be used in laboratories for the purpose of regulating hydrogen peroxide in Singapore.

### METHOD DEVELOPED FOR DETERMINING BOW DRAW WEIGHT

Under the current Arms and Explosives (Arms) Notification 2020, a bow with a draw weight of more than 27.215kg is classified as a controlled item in Singapore.



At the request of the Police Licensing & Regulatory Department, an in-house method was developed in October 2022 to measure and determine the draw weight and measurement uncertainties for two common types of bows – compound and non-compound bows.

### PRESERVATION OF BODY TISSUE SAMPLES

In mass fatality incidents, proper preservation of bodily remains is critical for maximising DNA recovery for victim identification. We developed a method using common table salt as a preservative. This method allows for long-term body tissue preservation without refrigeration, while at the same time maintaining compatibility with existing DNA processing workflows.

The preservation technique was recognised at the annual INTERPOL Disaster Victim Identification (DVI) conference in Lyon, France. The Forensic Genetics Sub-working Group has also suggested that the technique be incorporated into the INTERPOL DVI guide.



### NEW CAPABILITY FOR FUTURE PANDEMICS

We developed multiple Reverse Transcription (RT)-digital polymerase chain reaction (dPCR) assays for the quantification of SARS-CoV-2 RNA in copy-based units. It has traceability to the International System of Units, as well as superior precision and reproducibility as compared to RT-quantitative PCR. The knowledge gained from developing these RT-dPCR assays would enable us to offer External Quality Assessment Programmes and certified reference materials in future pandemics.





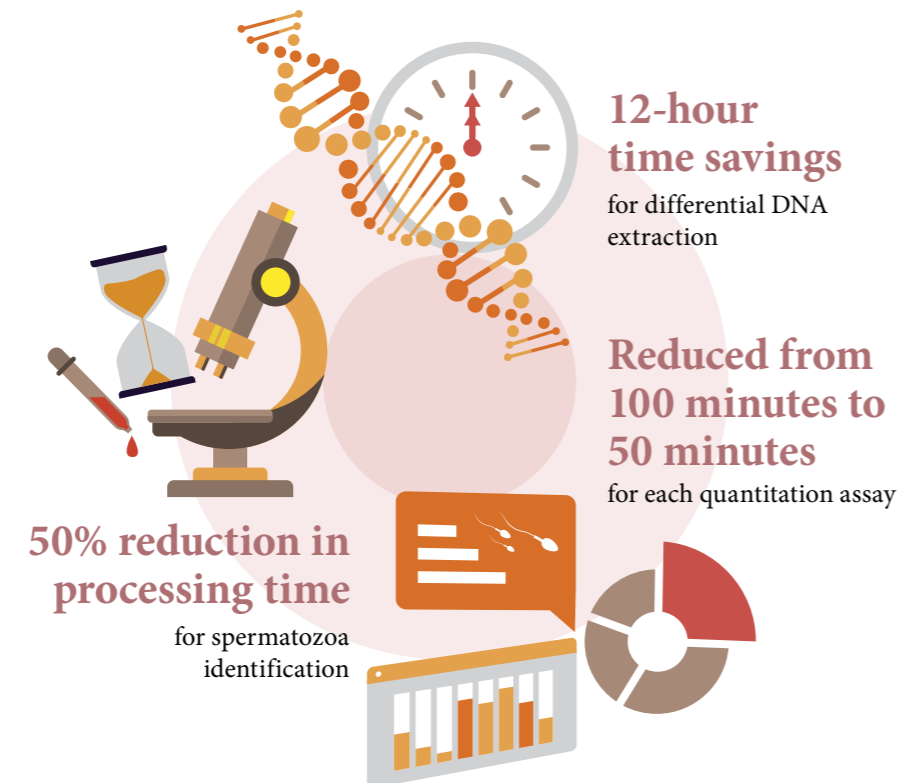
## ENHANCING OUR EFFICIENCY

We leverage the latest in science and technology to ensure maximum efficiency.

### ENHANCED PROCESSING OF SEXUAL OFFENCE SAMPLES

From 2015 to 2020, submissions of sexual offence samples increased by 370%. To manage the increased load, we optimised and re-engineered our work processes, which resulted in significant time savings.

These process improvements have enabled us to process samples within targeted turnaround times, without additional manpower or resources.



### SEMI-AUTOMATION OF DNA QUANTITATION AND CAPILLARY ELECTROPHORESIS

DNA quantification and capillary electrophoresis are important processing steps that precede the generation of a DNA profile. To enhance laboratory productivity, we integrated the use of an automated liquid handling workstation to semi-automate the setting-up of these processes.



Consistent performance was achieved along with a **30-45% reduction in man-hours**

### ENHANCED SCREENING WITH ROBOTIC PROCESS AUTOMATION (RPA)

We introduced RPA to screen for adulterants in complementary health products. By using RPA to automate the inter-quality control assessment and reporting outcomes, we were able to enhance work efficiency and productivity. It minimises the need for staff oversight, and upkeeps the stringent quality in accordance with ISO/IEC 17025:2017 requirements.

### AUTOMATED PROCESSING OF LOT RELEASE NOTIFICATION DATA FOR IMPORTED VACCINES

We developed a "Vaccine Lot Release Track" app to digitalise and automate the processing and management of lot release notification data submitted by companies for imported vaccines. The app alleviated laborious work processes, enabled traceability and improved overall work productivity. It also allowed us to conduct data analysis to analyse trends relating to lot release status.



## OUR LOCAL COLLABORATIONS

We place great emphasis on forging strong partnerships with local organisations to add value and build synergy.

### SINGAPORE POLICE FORCE (SPF)

To enhance emergency preparedness for DVI in mass fatality incidents (MFI), we conducted workshops together with SPF on the application of DNA kinship analysis in DVI. Participants included the United Nations Peacekeeping Force (UNPKF), who perform policing duties in overseas peacekeeping missions.

We also conducted a table-top exercise with SPF in January 2023 where we shared our international knowledge and experience on MFI.

### FORENSIC DIVISION OF SPF

In April 2022, we formed a Crime Scene Workgroup with SPF's Forensic Division, which would enable us to:

- Maximise DNA recovery of bloodstains at scenes
- Prioritise and triage case exhibits
- Reduce turnaround time by conducting joint examinations
- Streamline forensic examination involving multiple evidence types (e.g. DNA, fingerprints and trace materials) by having more frequent discussions on past scenes

### SINGAPORE JUDICIAL COLLEGE AND THE ATTORNEY-GENERAL'S CHAMBERS (AGC)

We gave a series of lectures to the Singapore Judicial College and the AGC on DNA analysis, updates on the New Psychoactive Substances situation, different drug sampling approaches, evaluative reporting and holistic assessment of evidence.

### SINGAPORE CIVIL DEFENCE FORCE (SCDF)

In April 2022, we held an exercise to share with SCDF the emergency response procedures for our Biosafety Level-4 Autopsy Suite – “Blue Box 2”. Our objectives included:

- Allowing SCDF to familiarise themselves with Blue Box 2 should they need to perform emergency evacuation of staff who collapse in the facility
- Giving our staff a chance to practise emergency response procedures in a simulated emergency
- Ensuring our liaison processes are kept up-to-date



### CLINICAL LABORATORIES

We collaborated with the National University Hospital, Ng Teng Fong General Hospital, Khoo Teck Puat Hospital and Parkway Laboratories to conduct an extensive commutability study on three new clinical certified reference materials (CRMs). These included:

- HRM-3007A: Creatinine, glucose, urea and uric acid in human serum
- HRM-3008A: Total cholesterol, HDL-cholesterol, LDL-cholesterol, and total glycerides in human serum
- HRM-3004A: Albumin and creatinine in human urine

The CRMs have been demonstrated to be closely similar to real patient samples on multiple mainframe analysers and are thus suited for use in calibration or as quality control for routine clinical assays.



## INTERNATIONAL PARTNERSHIPS

We continued to work closely with our international partners to set best practices and produce reference standards for greater accuracy.

### EUROPEAN NETWORK OF FORENSIC SCIENCE INSTITUTES (ENFSI)



**March 2022:** Actively participated in the revision of the ENFSI Guidelines for the training of staff in forensic DNA laboratories. The guidelines were successfully published for use by European forensic laboratories.



**November 2022:** As part of the ENFSI European Paint, Glass and Taggants Working Group, we worked on the revision of the Best Practice Manual for the Forensic Examination of Paint and its related guidelines.

### ASIAN FORENSIC SCIENCES NETWORK (AFSN)

From 2019 to 2022, HSA served as the president of AFSN, implementing many initiatives and uniting member institutes to continue to advance amidst the challenges brought by the COVID-19 pandemic.



**March 2022:** Hosted a Journal Club for the AFSN Questioned Document Workgroup.

**July 2022:** We organised the first AFSN Bloodstain Pattern Analysis (BPA) collaborative exercise, and an online session on Chemical Analysis of Unknowns/Materials.

**November 2022:** Together with the local organising committee from the Indonesian National Police, we hosted the 14<sup>th</sup> Asian Forensic Sciences Network Annual Meeting & Symposium in Jakarta, Indonesia.

### EUROPEAN DIRECTORATE FOR THE QUALITY OF MEDICINES & HEALTHCARE (EDQM)

#### ●● June 2022 – Official Medicines Control Laboratories (OMCL) Annual Meeting in Strasbourg, France

The 28<sup>th</sup> Annual Meeting of the European Network of OMCLs provided an effective platform for technical exchange and work-sharing, with the objective of maintaining coverage and depth of competence while remaining flexible and responsive in an evolving environment.



Attended by  
**>230 participants** from  
**36 countries**, representing  
**60 OMCLs and national competent authorities**

#### ●● March 2023 – European Committee for Cosmetic and Consumer Health Meeting, and Official Cosmetics Control Laboratories Meeting

The meetings covered recent technical advances and developments in cosmetic product testing.

### ASEAN ACTIVITIES

#### ●● 3<sup>rd</sup> ASEAN Pharmaceutical Testing Laboratory Committee (APTLC) Meeting

November 2022 – We chaired the 3<sup>rd</sup> Virtual APTLC Meeting to discuss and revise the activities under the 5-year APTLC Work Programme, including:

- Conducting surveys on testing and training needs, proficiency testing and collaborative study needs
- Compilation of test methods and guidelines adopted by all ASEAN member states in 2023



### ●● ASEAN Reference Substances Project on Chlorpropamide

The ASEAN Reference Substance Project, establishes ASEAN secondary drug reference standards for use in ASEAN member countries.

Singapore led the establishment of an ASEAN Reference Substance (PARS) – Chlorpropamide, through an inter-laboratory collaborative study. Through this project, the inter-laboratory study of Lumefantrine PARS, led by Indonesia, was also completed.

### ●● ASEAN Cosmetics Testing Laboratory Committee (ACTLC)

In March 2023, we were tasked to conduct a technical training session on “sample preparation on spray-type aerosol cosmetic products” coordinated by the ASEAN Secretariat.

## WORLD HEALTH ORGANIZATION (WHO)

We continued to actively support WHO activities under its Terms of Reference as its Collaborating Centre.

### ●● WHO Collaborating Centre for Drug Quality Assurance

Our Monograph Development Work for the International Pharmacopoeia included:

- On-going development of the draft monograph on 1-nitroso-4-methyl piperazine (MeNP) in Rifampicin products
- Supporting WHO to set up a test strategy, as well as evaluate an alternative high performance liquid chromatography (HPLC) methodology for the determination of diethylene glycol and ethylene glycol in liquid preparations for oral use
- Working on a draft monograph on Clofazimine, for inclusion into the International Pharmacopoeia

### ●● Meetings

- 56<sup>th</sup> Virtual WHO Expert Committee Meeting on Specifications for Pharmaceutical Preparations (April and May 2022)
- 4<sup>th</sup> Regional Forum of WHO Collaborating Centres in the Western Pacific (November 2022) in Siem Reap, Cambodia

- Hosted a WHO Collaborating Centres Meeting to explore new opportunities for better serving countries and regions, and increase the impact of the Centres’ work, and held a training session to build technical capacity among WHO member states

- Hosted the 7<sup>th</sup> Plenary Meeting of WHO Tobacco Laboratory Network in Singapore



### ●● WHO Collaborating Centre for Tobacco Testing and Research

We were invited to lead a WHO Global Method Validation study on smokeless tobacco products. This effort culminated in the publication of three WHO Standard Operating Procedures (SOP) in April 2022. The SOPs fill a very important regulatory void, especially in countries where smokeless tobacco products are prevalent and regulated.

## ASEAN REFERENCE MATERIAL NETWORK (ARMN) PROFICIENCY TESTING AND OUTREACH

In April 2022, ARMN metrology institutes co-organised a virtual forum-discussion session to conclude the joint Proficiency Testing (PT) programme on Toxic Elements in Lipstick Material.

The material was converted into the first cosmetic reference material produced as a joint effort between ARMN institutes.



## INTERNATIONAL PILOT STUDY ON HbA1c MEASUREMENT

Together with national metrology institutes in China, France and Republic of Korea, we initiated the first international pilot study on HbA1c measurement based on the isotope dilution mass spectrometry reference method. Our involvement included providing participating metrology institutes with purified signature hexapeptides as calibrators for the measurements.

## PROVIDING DRUG-RELATED TRAINING FOR INTERNATIONAL COUNTERPARTS

We conducted training programmes for foreign officials from 17 countries to share on Singapore's comprehensive drug control strategies, drug analysis methodologies and to provide a platform for participants to share and exchange best practices.

- **July 2022 & February 2023:** Virtual trainings on drug analysis and identification for law enforcement officers and forensic practitioners from African countries
- **October 2022:** Laboratory visit from law enforcement officers from African, East and Southeast Asian countries



## INTERNATIONAL ENGAGEMENTS

### ●● APEC Project SCSC-01 2021, Building Laboratory Capabilities to Assure Water Quality in Asia Pacific Economies

**March 2022 & March 2023:** This project saw us joining metrology institutes and accreditation bodies to co-organise two workshops aimed at building laboratory capabilities in the measurement of water quality in Asia Pacific economies.

### ●● Visit to the National Board of Forensic Medicine & National Forensic Centre in Linköping, Sweden

**May-June 2022:** The deep insights gained from visiting the DNA section of the Swedish forensic laboratories in Linköping, has provided ideas for implementation here.

### ●● International Society for Forensic Genetics (ISFG) Conference

**August-September 2022:** Invited as a panelist to share on our approaches to dealing with mixture profiles from high volume crimes, Y chromosomal testing, and activity level reporting.

### ●● 9<sup>th</sup> International Conference on New Psychoactive Substances (NPS)

**October 2022:** Invited by the International Society for the Study of Emerging Drugs (ISSED) to share our workflow and strategies for identification of NPS.

### ●● Training on General Requirements for the Competence of Reference Material Producers (ISO 17034:2016)

**November 2022:** Co-conducted a virtual training on ISO 17034:2016 together with the National Institute of Metrology, Thailand and Department of Science Service, Thailand.

### ●● 20<sup>th</sup> Standing Committee Meeting of Western Pacific Regional Forum for the Harmonization of Herbal Medicines (FHH)

**February 2023:** Two of our scientists presented on determination and analysis of substances using mass spectrometry.

### ●● 9<sup>th</sup> FHH International Symposium

**February 2023:** The meeting and symposium covered topics relating to the regulation of Chinese medicines, Chinese proprietary medicines, updates on pre- and post-market activities, risk management strategies for new traditional Chinese medicine safety, and quality control and test method development for herbal drugs.



## SHARING OUR EXPERTISE

In the spirit of learning and fostering closer professional ties, we endeavour to share our knowledge and experience with counterparts both locally and overseas.

### INVITATIONS TO CONDUCT PEER REVIEWS AND TECHNICAL ASSESSMENTS

HSA was invited by established metrology institutes, the Korea Research Institute of Standards and Science, and the Government Laboratory (Hong Kong, China) to conduct peer reviews.

These reviews were done following the requirements of the International Committee for Weights and Measures Mutual Recognition Arrangement (CIPM MRA).

We were also invited by Australia's National Association of Testing Authorities to conduct technical assessments for its national metrology institute, the National Measurement Institute.

### REVISION OF SINGAPORE ACCREDITATION COUNCIL (SAC) TECHNICAL GUIDE

We provided our expertise towards the major revision of the *SAC Technical Guide 2: A Guide on Measurement Uncertainty in Chemical & Microbiological Analysis*. The guide provides clear guidance and updated examples on the evaluation of measurement uncertainty (required under ISO/IEC 17025).

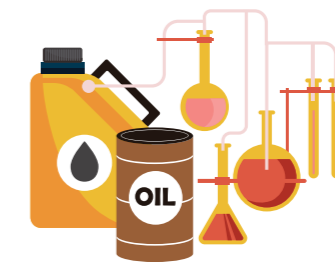
### PARTNERING WITH UNODC ON CANNABIS ANALYSIS

We contributed to the revised manual, *Recommended Methods for the Identification & Analysis of Cannabis and Cannabis products*, which was published by the United Nations Office on Drugs and Crime (UNODC) in March 2022.

### SUPPORTING SINGAPORE'S BUNKERING SECTOR

HSA was a member of an industry expert group co-chaired by the Maritime and Port Authority of Singapore (MPA) and the Singapore Shipping Association (SSA) to strengthen fuel quality assurance measures and to establish a comprehensive list of chemical compounds to be tested.

In April 2022, together with representatives from MPA and marine offshore testing bodies, we conducted a technical workshop on organic contaminants in marine fuel oil.



The workshop was attended by **50 representatives** from **15 fuel oil testing laboratories** in Singapore.

### HYBRID EXTERNAL QUALITY ASSESSMENT (EQA) PROGRAMME SYMPOSIUM

The symposium saw staff from local clinical laboratories and clinics discussing the results of a voluntary programme in clinical chemistry comprising 17 clinical makers, and the national programme for HbA1c testing.





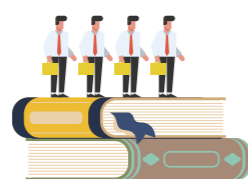
# BENCHMARKING OF MEASUREMENT CAPABILITIES

Benchmarking plays an important role in ensuring the reliability of our measurement results.

## BENCHMARK COMPARATIVE STUDY ON UNKNOWN PHARMACEUTICAL PRODUCT



In a comparative study organised by European Directorate for the Quality of Medicines & Healthcare (EDQM), we successfully identified controlled drug methylcodeine as the unknown ingredient of the product provided. The study outcome reaffirms our proficiency in structural elucidation of unknown chemical substances.



The study comprised  
**26 members**  
from the General European  
Official Medicine Control  
Laboratories Network (GEON).

## PROFICIENCY TESTING (PT) SCHEME STUDIES

We achieved excellent results in the following benchmark PT programmes:

### ●● Pharmaceutical Laboratory

- Screening and quantitation of suspicious unknown Active Pharmaceutical Ingredients by European Directorate for the Quality of Medicines & HealthCare (EDQM)
- Assay of Cimetidine tablets by UV-VIS Spectrophotometry by Bureau of Drug & Narcotic (BDN)
- Assay of Atenolol Tablets by Liquid Chromatography by EDQM
- Determination of N-nitroso-dimethylamine (NDMA) in valsartan tablets by liquid chromatography tandem mass spectrometry by EDQM
- Assay of Heavy metals by inductively-coupled plasma mass spectrometry (ICP-MS) by Laboratory of the Government Chemist (LGC)
- Assay of Cannabidiol by Liquid Chromatography by LGC
- Assay of Sildenafil in Supplements by Liquid Chromatography by LGC
- Potentiometric determination of pH in Ciprofloxacin injection by BDN

### ●● Cosmetics Laboratory

- Identification of Hydroquinone, Mercury Compounds and Retinoic Acid in cream by Liquid Chromatography ICP-MS by ASEAN

### ●● Cigarette Testing Laboratory

- Assay of Nicotine, Propylene Glycol, Glycerol in e-Liquids by Gas Chromatography with flame ionisation detection (GC-FID) by Laboratory of the Government Chemist (LGC)



# AWARDS AND ACHIEVEMENTS

Our awards and achievements reflect our commitment to excellence.

## PHARMACEUTICAL DIVISION (PD)

### ●● ISO/IEC 17025:2017 Assessment

PD achieved full compliance to ISO/IEC 17025:2017 in its Singapore Accreditation Council (SAC) SINGLAS renewal assessment. In this latest assessment, the laboratory expanded its scope of accreditation to include three new tests: (1) Identification of common drugs by LTQ XL Linear Ion Trap Mass Spectrometry, (2) Identification of common drugs by LC-HRMS and (3) Identification of Artemisinin in health products by LC-MS/MS.

In recognition for PD's consistent performance and demonstration of excellence in Quality Management System, they were granted Extended Surveillance. This means that the labs will only be assessed by SAC SINGLAS every one-and-a-half years.

## CHEMICAL METROLOGY LABORATORY (CML)

### ●● ISO/IEC 17025:2017 and ISO 17034:2016 Peer Review

In February and March 2023, CML successfully completed a remote peer review by SAC, as well as an on-site peer review by a team of experts from the international chemical metrology community.

### ●● Accreditation as a Proficiency Testing (PT) Provider

In April 2022, CML also completed a surveillance assessment by SAC and maintained its accreditation as a PT/External Quality Assessment (EQA) Provider in accordance with the requirements of ISO/IEC 17043:2010. CML remains the only SAC-accredited Provider of PT/EQA Programmes in 2022.

## CROSS-AGENCY PUBLIC SECTOR TRANSFORMATION AWARD

In July 2022, the HSA Biologics Team and Bioprocessing Technology Institute (BTI) Project Team jointly won the "Dare to Do Award" (Public Service Transformation Awards) for their Rapid Development and Implementation of COVID-19 Vaccine Lot Release Testing Platform.



They overcame extreme challenges and successfully developed assays for certain COVID-19 vaccines at an unprecedented pace. This experience is invaluable to building up Singapore's resilience in the fight against COVID-19 and future diseases.

## NATIONAL COVID-19 AWARDS

- Dr Paul Chui – Public Administration Medal (Silver) (COVID-19)
- Dr Lee Chin Thye and Dr Wu Jia Hao – Public Administration Medal (Bronze) (COVID-19)
- Mr Abdul Kalai Mony, Mr Ravi Subramaniyan and Mr Sevugan Subbiah – Commendation Medal (COVID-19)
- Forensic Medicine Division – President's Certificate of Commendation (COVID-19)

## ROCHE LABORATORY MEDICINE (TECHNICAL) AWARD BY SINGAPORE SOCIETY OF PATHOLOGY

Mr Balakrishnan Periathamby Nagan was awarded the Roche Technical Award 2022, for his significant contributions to the practice of pathology.

