SECOND MEETING OF THE WESTERN PACIFIC REGION EMERGING MOLECULAR PATHOGEN CHARACTERIZATION TECHNOLOGIES (EMPACT) SURVEILLANCE NETWORK

1–2 September 2022
Manila, Philippines
MEETING REPORT

Second Meeting of the Western Pacific Region Emerging Molecular Pathogen Characterization Technologies (EMPaCT) Surveillance Network

Convened by:

WORLD HEALTH ORGANIZATION
REGIONAL OFFICE FOR THE WESTERN PACIFIC

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1–2 September 2022

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NOTE

The views expressed in this report are those of the participants of the Second Meeting of the Western Pacific Region Emerging Molecular Pathogen Characterization Technologies (EMPaCT) Surveillance Network and do not necessarily reflect the policies of the conveners.

This report has been prepared by the World Health Organization Regional Office for the Western Pacific for Member States in the Region and for those who participated in the Second Meeting of the Western Pacific Region Emerging Molecular Pathogen Characterization Technologies (EMPaCT) Surveillance Network in Manila, Philippines from 1 to 2 September 2022.
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KEYWORDS:

Capacity Building / Genome-Wide Association Study – Methods / Public Health Surveillance / Regional Health Planning
Summary

Genomic surveillance has played a critical role in the coronavirus disease (COVID-19) pandemic response, enabling countries to detect and characterize SARS-CoV-2 variants of concern (VOCs) and variants of interest (VOIs) to guide the implementation of public health and social measures.

The inaugural meeting of the Western Pacific Region Emerging Molecular Pathogen Characterization Technologies (EMPaCT) Surveillance Network took place in September 2021. Since then, many Member States have rapidly expanded their genomic sequencing activities. However, this capacity is unevenly distributed throughout the Region.

The Second Meeting of the Western Pacific Region EMPaCT Surveillance Network was held virtually on 1-2 September 2022. Participants described experiences and lessons identified during the recent waves driven by the Omicron variant, as well as progress made towards establishing genomic surveillance systems. Member States and technical working group members discussed with partners how to build on the lessons and experiences in a country-specific, step-by-step approach.

The participants concluded that genomic surveillance is an important tool for response decision-making. The EMPaCT seven-step approach can act as a useful guide towards developing genomic surveillance, but commitment from decision-makers for sustainable investment is essential. Strengthening genomic sequencing capacity, including external quality assessments, and building capacity to assess transmissibility, severity and impact at national and subnational levels are important next steps, which can be achieved by continuing to build on existing strong regional cooperation, technical collaboration and solidarity.

Member States are encouraged to take action towards developing and strengthening access to sustainable genomic surveillance systems. The WHO Secretariat and partners are recommended to provide technical and strategic support to Member States in a coordinated way under the EMPaCT Surveillance Network.
1. Introduction

The Second Meeting of the Western Pacific Region Emerging Molecular Pathogen Characterization Technologies (EMPaCT) Surveillance Network was hosted in Manila, Philippines from 1 to 2 September 2022, with participants attending remotely by video.

1.1 Organization of the meeting

Temporary advisers, Dr Eka Buadromo, Dr Thilaka Chinnayah, Professor Ben Howden, Dr Sarah Jefferies, Dr Erik Karlsson, Professor Li Mingkun, Dr Cui Lin, Dr Janice Lo and Dr Tomoya Saito, were introduced to the participants. Temporary advisers served as moderators for the various plenary and parallel sessions.

Annex 1 lists the programme of activities. Annex 2 lists the participants.

1.2 Objectives

The objectives of the meeting were:

- to agree on a plan to implement the EMPaCT seven-step approach to developing a sustainable in-country genomic surveillance system that takes into consideration the country context;
- to improve coordination and effectiveness of the EMPaCT Surveillance Network activities and to support Member States to maintain appropriate access to gene sequencing and develop genomic sequencing capacity; and
- to stimulate discussions on practical steps for sharing and using genomic surveillance information in public health decision-making.
2. Proceedings

2.1 Opening session

Dr Babatunde Olowokure, Regional Emergency Director (RED), WHO Regional Office for the Western Pacific, welcomed the representatives of Member States, temporary advisers, partners and other participants to the second Meeting of the Western Pacific Region Emerging Molecular Pathogen Characterization Technologies (EMPaCT) Surveillance Network.

Dr Olowokure pointed out that Member States successfully responding to the COVID-19 pandemic share similar attributes of strong leadership and effective mechanisms to maintain strong lines of communication between central and local governments. These countries continue to learn and improve their response efforts and work closely with partners in a collaborative and strategic manner. Lastly, these countries leveraged response mechanisms developed over the past 16 years through implementation of the Asia Pacific Strategy for Emerging Diseases and Public Health Emergencies (APSED III).

During the recent APSED Technical Advisory Group (TAG) meeting in 2022, it was concluded that the strategic framework of APSED has served us well. However, COVID-19 showed that there were still areas that required improvement and strengthening. As such, it is now time for a new regional health security action framework. It was also discussed that Member States used the learn-and-improve mechanism during the COVID-19 pandemic to refine their responses coordinated by the WHO Regional Office by taking a step-by-step system-building approach that fits the country context and will allow Member States to effectively detect and address future public health emergencies. This will contribute to the For the Future vision of making this the healthiest and safest region.

It is crucial that we take the lessons from COVID-19 to improve further and incorporate elements like genomic sequencing into multi-source surveillance systems to achieve our next-generation surveillance system.

At last year's meeting of the EMPaCT Surveillance Network, the WHO Regional Office introduced the EMPaCT seven-step approach, which incorporates the lessons and principles of APSED. It was well received and accepted by Member States, temporary advisers and partners.

2.2 Plenary 1: Setting the scene

Professor Ben Howden, Director, Microbiological Diagnostic Unit, Public Health Laboratory (MDU PHL), Department of Microbiology and Immunology, The University of Melbourne, was the moderator of this session.

In the Western Pacific Region, experiences from the COVID-19 pandemic have highlighted the critical role of genomic surveillance in responding to COVID-19. This first plenary focused on the importance of genomic surveillance systems. There was also discussion on applying the APSED two-tier approach in responding to emergencies (the first tier being emergency planning, the second tier being system readiness) towards developing a genomic surveillance system.
2.2.1 Genomic surveillance system development: A seven-step approach  
*Presenter: Tamano Matsui, WHO Regional Office for the Western Pacific*

The purpose of this session was to introduce the core concept of the EMPaCT seven-step approach (Fig. 1) as a basis for the two-day discussion. This approach reflects our lessons and experiences during the COVID-19 pandemic to deal with multiple waves of COVID-19 due to changes in the circulating virus’s characteristics of transmissibility, severity and impact.

Member States have been adjusting public health and social measures depending on the characteristics of the circulating Variants of Concern (VOCs) and Variants of Interest (VOIs) to break the chain of transmission effectively while minimizing the economic and social impacts.

**Fig. 1. A seven-step approach to developing a genomic surveillance system**

There are three phases in the EMPaCT seven-step approach to system development.

**Phase 1** is to detect (step 1), monitor (step 2) and assess (step 3) known SARS-CoV-2 VOCs/VOIs. Detection, monitoring and assessment of known SARS-CoV-2 VOC/VOIs is used as an opportunity for core component development of the genomic surveillance system.

**Step 1: Detect known SARS-CoV-2 VOCs/VOIs**

<table>
<thead>
<tr>
<th>Goal in system development</th>
<th>Develop laboratory capacity to meet country needs for a genomic surveillance system.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core function</td>
<td>To be able to detect known VOCs/VOIs by public health laboratories.</td>
</tr>
<tr>
<td>What to do</td>
<td>Laboratory capacity development</td>
</tr>
<tr>
<td></td>
<td>1. Decide where to develop gene sequencing capacity and the timeline.</td>
</tr>
</tbody>
</table>
2. Decide on a human resources plan, including training.
3. Conduct monitoring and evaluation (M&E) regarding quantity and quality of the work and workforce.
Note: For resource-limited settings, ensuring access to gene sequencing should be considered the initial step of capacity development in step 1.

Step 2: Monitor the prevalence of known SARS-CoV-2 VOCs/VOIs

<table>
<thead>
<tr>
<th>Goal in system development</th>
</tr>
</thead>
<tbody>
<tr>
<td>Develop a resilient and nationally coordinated sampling system for genomic surveillance to be sustainable and adaptable to a changing situation.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Core function</th>
</tr>
</thead>
<tbody>
<tr>
<td>To monitor the prevalence of known VOCs/VOIs for public health decision-making (e.g. calibrating public health and social measures) through representative sampling.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>What to do</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall system design</td>
</tr>
<tr>
<td>1. Have a consensus among the stakeholders about what is desired to be known by monitoring trends of known VOCs/VOIs through representative sampling.</td>
</tr>
<tr>
<td>2. Pre-define expected response action(s) depending on the results.</td>
</tr>
<tr>
<td>3. Build consensus among the stakeholders that a ‘command control mechanism’ is necessary to modify operations depending on changes in priority VOCs/VOIs.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>System development</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Identify appropriate platforms (e.g. sentinel clinics) to meet the country context.</td>
</tr>
<tr>
<td>2. Decide on a budget plan.</td>
</tr>
<tr>
<td>3. Discuss a testing algorithm (e.g. a combination of genomic sequencing and single-nucleotide polymorphism [SNP] detection polymerase chain reaction [PCR]) which takes into account objectives, available resources and feasibility in changing context (e.g. priority VOCs/VOIs).</td>
</tr>
<tr>
<td>4. Conduct M&amp;E.</td>
</tr>
</tbody>
</table>

Step 3: Assess transmissibility, severity and impact of known SARS-CoV-2 VOCs/VOIs

<table>
<thead>
<tr>
<th>Goal in system development</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Develop a competent rapid response team (RRT) to be able to detect ‘unusual’ events in the field in terms of transmissibility, severity and impact of circulating SARS-CoV-2 VOCs/VOIs.</td>
</tr>
<tr>
<td>• Develop a well-trained RRT in the field to be able to assess transmissibility, severity and impact of circulating SARS-CoV-2 VOCs/VOIs.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Core function</th>
</tr>
</thead>
<tbody>
<tr>
<td>To monitor transmissibility, severity and impact of circulating strains appropriately in the field in terms of:</td>
</tr>
<tr>
<td>• being able to detect unusual events in a timely and efficient manner</td>
</tr>
<tr>
<td>• using available clinical, epidemiology and laboratory information appropriately.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>What to do</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall system design</td>
</tr>
<tr>
<td>• To identify what information exists in the country to assess transmissibility, severity and impact at the national and subnational levels.</td>
</tr>
<tr>
<td>• To define the role of RRT in the field regarding the assessment of transmissibility, severity and impact and have consensus on the value of having a trained RRT in the field.</td>
</tr>
<tr>
<td>• To pre-define expected actions depending on the results.</td>
</tr>
</tbody>
</table>
Systems development
1. Consider whether available channels (e.g. hospital-based EBS) are suitable/adequate to detect unusual events with regard to transmissibility or severity, efficiently and effectively.
2. If a system adjustment is needed, planning with related stakeholders is required.
3. Assess the capacity of the RRT at the subnational level and determine whether the team is well trained in assessments of transmissibility and severity.
4. Develop a plan for capacity development including training for the RRT.
5. Develop an operational plan in case an unusual event is detected with respect to transmissibility/severity at the subnational level.
6. Conduct M&E.

Phase 2 is to detect (step 4), monitor (step 5) and assess (step 6) new SARS-CoV-2 VOCs/VOIs. The surveillance system developed through phase 1 (steps 1–3) are used to be ready to detect and respond to new VOCs/VOIs.

Step 4: Detect new VOC/VOI via an available mechanism

<table>
<thead>
<tr>
<th>Trigger used to activate</th>
</tr>
</thead>
<tbody>
<tr>
<td>A highly transmissible and/or severe strain is circulating locally but does not match a known VOC/VOI.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>To detect a new* VOC/VOI appropriately.</td>
</tr>
</tbody>
</table>

*New does NOT mean new to the country (has not been detected in any country, so new globally).

<table>
<thead>
<tr>
<th>What to do for preparation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preparation</td>
</tr>
<tr>
<td>• Make sure that steps 1–3 are functioning well.</td>
</tr>
<tr>
<td>• Prepare an appropriate command mechanism to switch step 4 ON in the country.</td>
</tr>
<tr>
<td>• Prepare appropriate laboratory referral mechanisms (including through international collaboration).</td>
</tr>
</tbody>
</table>

Step 5: Monitor new VOC/VOI

<table>
<thead>
<tr>
<th>Trigger used to activate</th>
</tr>
</thead>
<tbody>
<tr>
<td>A new VOC/VOI that meets the WHO definition is identified in the country.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>To monitor the prevalence of the newly identified VOC/VOI in the country as appropriate.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>What to do for preparation</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Make sure that steps 1–3 are functioning well.</td>
</tr>
<tr>
<td>• Signal to the appropriate command mechanism to switch step 5 ON in the country.</td>
</tr>
<tr>
<td>• Prepare a plan for enhanced surveillance to maximize the value of step 2.</td>
</tr>
</tbody>
</table>

Step 6: Assess transmissibility, severity and impact of identified new SARS-CoV-2 VOC/VOI

<table>
<thead>
<tr>
<th>Trigger used to activate</th>
</tr>
</thead>
<tbody>
<tr>
<td>A new VOC/VOI meeting the WHO definition is identified in the country.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>To assess the transmissibility, severity and impact of the newly identified SARS-CoV-2 VOC/VOI in a timely manner.</td>
</tr>
</tbody>
</table>
What to do for preparation

- Through step 3, capacity development of RRT, a collaboration mechanism has already been established:
  - with the public health sector including epidemiologists and clinicians
  - at public health sectors at national and subnational levels.
- Signal to the appropriate command mechanisms to switch step 6 ON in the country.
- Set up an investigation team at the national level,
- Establish familiarity with international support mechanisms (e.g. GOARN).

Phase 3 is to detect and respond to new emerging infectious diseases (EIDs) with pandemic potential through all available mechanisms. Surveillance systems developed through phase 1 (steps 1–3) and phase 2 (steps 3–6) are used to be ready to detect and respond to new EIDs.

Step 7: Detect through all available mechanisms

<table>
<thead>
<tr>
<th>Trigger used to activate</th>
<th>An unusual event is identified in the country.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goal</td>
<td>To detect EIDs through all available mechanisms (such as through surveillance systems and laboratory capacity).</td>
</tr>
<tr>
<td>What to do for preparation</td>
<td>Build a framework to find the unusual event from clinical (e.g. hospital-based EBS) or epidemiological settings (e.g. EBS from schools or factories) and link it with laboratory diagnostics.</td>
</tr>
<tr>
<td></td>
<td>Develop laboratory capability to perform genomic sequencing of unknown pathogens (including through international collaboration).</td>
</tr>
</tbody>
</table>

The EMPaCT seven steps provide a practical approach to system development in the Region to organize available resources to meet the new demand for surveillance that includes genomic information. Genomic surveillance provides key information as part of a multi-source surveillance system that can be utilized for public health decision-making.

Each step has a well-defined scope for developing the system and a specific workforce or cadre. Several steps can be developed simultaneously (especially steps 1–3). Through efforts to respond to COVID-19, each Member State can develop a resilient surveillance system that has the potential to detect and respond to new potential threats (e.g. EIDs with pandemic potential) appropriately.

2.3 Plenary 2: Country experiences of genomic surveillance

Plenary 2 was moderated by Dr Thilaka Chinnayah and Dr Eka Buadromo.

Representatives from countries in the Western Pacific Region shared how they utilized their genomic surveillance information in response to the COVID-19 pandemic.

They also shared their challenges, both in the laboratory and with public health responses, and their next steps to achieve a sustainable in-country genomic surveillance system to further respond to COVID-19 and prepare for future emerging infectious diseases with epidemic and pandemic potential.
2.3.1 Country presentations

**Whole genome sequencing (WGS): Australia’s experience**  
*Presenter: Amy Black, Office of Health Protection, Australia*

- The Government’s recognition of the importance of including genomic data in public health surveillance led to national coordination.
- This coordination ensured that sequencing information helped guide public health and social measures (e.g. mask wearing, social distancing and lockdowns) and allowed monitoring of viral evolution and characterization.
- The creation of a governance framework for data sharing led to role definition for involved entities. It established the custodianship of sequencing data as they were the generators of these data. In turn, this promoted metadata sharing and analyses at the national level.
- Australia adjusted its sampling strategy from sequencing all cases to selective sequencing while maintaining representation for trend analyses. This allowed Australia to harness the value of sequencing while acknowledging finite sequencing capacity and resources.

**Western Pacific Region EMPaCT Surveillance Network**  
*Presenter: Shalini Singh, Fiji CDC, Health Protection Unit, Ministry of Health, Fiji*

- Laboratory diagnostic capacity existed for multiple pathogens prior to the COVID-19 pandemic.
- Importantly, through enrolment in multiple pathogen EQA programmes, laboratory testing quality was continually assessed and maintained.
- Prior relationships with the Victorian Infectious Diseases Reference Laboratory (VIDRL) and the Microbiological Diagnostic Unit Public Health Laboratory (MDU PHL), and ongoing communication with these two reference laboratories facilitated an easy sample referral process at the start of the pandemic.
- Through existing relationships with referral laboratories, Fiji CDC benefited from worksheets, guidelines, standard operating procedures and genome interpretation and reporting assistance, which were adjusted continually for the current context.
- With support from donors and partners, Fiji CDC was able to access private testing laboratories in Australia to clear sample testing backlogs.
- The identification of VOCs through referral sequencing led to calibration of public health and social measures in Fiji (e.g. reintroduction of mask wearing, messaging around booster doses and infection prevention and control measures).
- WGS capacity in Fiji has been developed through the efforts of partners like MDU PHL, Department of Foreign Affairs and Trade (DFAT), Australia, The Pacific Community (SPC) and the World Bank, and with continual support from WHO.

**Whole genome sequencing: Malaysia’s experience**  
*Presenter: Santhi Subramanian, National Public Health Laboratory, Malaysia*

- WGS activities related to the COVID-19 pandemic were initiated in early 2020; its capacity was increased by expanding testing from just central laboratories to hospitals and other laboratories.
- A surveillance genomics consortium was established to allow variant monitoring and adjustments to sample selection criteria.
- A data dashboard is used to compare case numbers, hospitalization rates, ICU utilization, and mortality between the different variants.
- To overcome challenges posed by increasing reliance on SARS-CoV-2 antigen rapid diagnostic testing (and thus decreasing samples for PCR and WGS), laboratories initiated investigations into protocols to obtain sequencing data from poor-quality samples or those with low viral loads (Ct >30).
• Strengthening wastewater surveillance and development of protocols for detecting SARS-CoV-2 in wastewater are ongoing. Wastewater surveillance has been used to observe community transmission trends and early, unbiased detection of variants.

Genomic surveillance for decision-making and genomic sequencing capacity development: Mongolia’s experience
Presenter: Oyungerel Darmaa, National Influenza Center, National Center for Communicable Diseases (NCCD), Mongolia
• As part of the recommendations following the 2019 National Influenza Center meeting to build WGS capacity to monitor viral evolution, Mongolia began to build sequencing capabilities. Initially, through reliance on sample referral to NIID, Japan, and later through on-site training, NCCD developed its own sequencing capacity in December 2021.
• In-country technical expertise from NIID and WHO and ongoing (biweekly) calls with NIID and WHO have helped troubleshoot protocol challenges and enabled reliable sequencing performance.
• In July 2022, the Ministry of Health approved the integrated guidelines for Influenza and COVID-19 using the existing influenza surveillance system.
• The Ministry of Health utilized the in-country detection of VOC Omicron BA.4 and BA.5 to increase risk communication to the public by encouraging mask wearing and social distancing. In addition, this detection was used to increase testing levels and prepare the health capacity for a surge in cases.

Severe viral pneumonia surveillance and SARS-CoV-2 genomic surveillance in Viet Nam
Presenter: Luong Chan Quang, Pasteur Institute in Ho Chi Minh City, Viet Nam
• Severe viral pneumonia (SVP) surveillance has been ongoing, guided and coordinated by the Ministry of Health as a functional programme since 2003. It was established after the first detection of an avian Influenza case in humans in Viet Nam. This surveillance is conducted through all hospitals in the country with support from the local authorities.
• The first COVID-19 cases of each wave in Viet Nam were identified through the SVP surveillance system.
• The shift from using sequencing for research purposes to including it in public health surveillance is ongoing. This has been achieved by expanding sequencing capacity to multiple regional laboratories. Genomic surveillance has played a crucial role in tracking the spread of SARS-CoV-2 and identifying chains of transmission.
• Results from genomic surveillance were used to guide public health action, including border closures, social distancing and mask wearing during the COVID-19 response.

2.3.2 Facilitated discussion
• It is important to consider shifting from a “sequence all” approach to representative and targeted sequencing of specific samples. This decision should take into account available resources and be discussed with public health and epidemiology units.
• Internal and external quality assurance procedures are extremely important to consider when establishing a genomic surveillance system.
• It is important to have systems to address incomplete or missing metadata accompanying samples. Some Member States reported having systems to contact hospitals for missing data.
• Fiji is currently establishing in-country WGS capacity. After establishment and implementation, Fiji is willing to serve as a sequencing referral centre for other Pacific island countries.
• Sample selection strategies need to be assessed from time to time. These strategies apply to both in-country sample selection and the selection of samples for referral testing. It is important to
specify that these strategies will render the sampling not truly representative, and selection bias will need to be accounted for in prevalence and trend calculations.

- Consider the use of SNP detection PCR to complement WGS to save on resources, but still obtain relevant information to guide public health decision-making.

### 2.4 Plenary 3: Towards implementation of EMPaCT steps 1 and 2

Dr Cui Lin and Dr Sarah Jefferies opened the plenary. While Member States were responding to the COVID-19 pandemic, it became evident that regional mechanisms for supporting the development of a genomic surveillance system or ensuring accessibility to genomic sequencing for resource-limited countries are essential. The system is envisioned to respond to the ongoing COVID-19 pandemic and prepare for future pandemics and health emergencies.

#### 2.4.1 Towards implementation of EMPaCT steps 1 and 2: Overall training plan

*Presenter: Shilpa Iyer and Satoshi Shimada, WHO Regional Office for the Western Pacific*

Dr Iyer and Dr Shimada presented elements that can be used to enhance and strengthen the national and subnational EID responses, as well as the EMPaCT surveillance network, to support and enable an environment for enhancing national response systems.

The overall training plan focused on the implementation of steps 1 and 2, which are part of phase 1, and these steps together are focused on detecting and monitoring known variants of SARS-CoV-2.

- Through a survey, Member State institutes identified gaps in their capacities, and addressing these gaps will help build capacity in the public health sector.
- The institutes identified personnel having very limited molecular experience as the main target for training and capacity-building.
- About 70% of individuals desiring training had no experience in WGS and very limited molecular testing experience.
- Incorporation of online pre-training study materials and post-training evaluation is planned to improve training efficiency.
- The institutes expressed strong interest in utilizing WGS data along with epidemiological data for public health decision-making

#### 2.4.2 Country presentations

**Genomic surveillance system development: The Lao People’s Democratic Republic**

*Presenter: Bouaphanh Khamphaphongphane, National Center for Laboratory and Epidemiology (NCLE), Lao People’s Democratic Republic*

- The country is strengthening event-based surveillance through targeted sampling for genomic sequencing. They also have an influenza sentinel surveillance system that can support representative sampling. There are current discussions to strengthen some influenza sentinel sites to support representative sampling for genomic sequencing of SARS-CoV-2 as part of step 2 of the EMPaCT seven-step approach.
- The next step is to finalize the roadmap for in-country genomic surveillance.

**Towards implementation of EMPaCT steps 1 and 2: Cambodia**

*Presenter: Ly Sovann, Communicable Disease Department, Cambodia*
- Cambodia expanded the number of laboratories during the COVID-19 pandemic to increase PCR testing capacity and implemented quality control management systems. There is still a need to improve quality assessment, logistical management and equipment maintenance at laboratories.
- The pandemic has been an opportunity to considerably advance sequencing capacity at the National Institute of Public health (NIPH). It is now fully functional in two institutes (Institut Pasteur du Cambodge [IPC] and NIPH). From January to June 2022, NIPH uploaded 173 sequences to GISAID.
- A strategy for sampling is being developed to support detection (targeted sampling) and monitor the prevalence (representative sampling) of known SARS-CoV-2 VOCs/VOIs. However, the challenge in Cambodia remains a resilient, coordinated and sustainable sampling system to support genomic surveillance.
- The next steps include finalizing the sampling strategy, determining the role of COVID-19 laboratories for genomic surveillance, addressing data sharing issues such as data protection and the legal environment, and building the capacity of RRTs for step 3.

**Sampling for COVID-19 whole genome sequencing: The Philippines**

*Presenter: Alethea De Guzman, Department of Health, Republic of the Philippines*

- The Delta wave in the Philippines resulted in the largest number of hospitalizations and deaths and the highest hospital bed occupancy, especially of ICU beds.
- WGS has provided strong evidence supporting the need for stronger border control through the Country Classification System, successfully suppressing the transmission of new variants. Quarantine and isolation strategies have been updated based on current knowledge of the circulating virus.
- Genomic surveillance helped to reinforce community-led activities to motivate individual and social responsibility, alleviate stretched health systems, and protect the most vulnerable through the updated Pandemic Surge Preparedness and Response Plan.
- The Department of Health (DOH) plans to create a Philippine Genomic Surveillance Consortium to cover COVID-19 and other infections, strengthen its One Health activities and the Public Health Laboratory Network, and pilot wastewater surveillance for SARS-CoV-2.
- The DOH and sequencing laboratory partners are requesting capacity-building and assistance for surveillance system strengthening, bioinformatics and outbreak investigation.

**2.4.3 External quality assessment (EQA)**

**SARS-CoV-2 genome surveillance in Japan: external quality assessment**

*Presenter: Makoto Kuroda, Pathogen Genomics Center, National Institute of Infectious Diseases (NIID), Japan*

Dr Kuroda presented the experience of coordinating an EQA in Japan. At the beginning of the pandemic, laboratories at the local level sent all PCR-positive samples to NIID for sequencing analysis at a rate of 5000 samples per week. During this process, NIID developed standard operating procedures and videos suitable for training beginners. By conducting technical trainings, a total of 69 local public health laboratories were trained to perform viral whole genome sequencing. Nationally, sequencing levels are currently at approximately 4000 samples per week. All 69 local laboratories currently upload sequencing data to NIID servers so that a national summary can be reported to the Japanese Government.

Sixty-four of the 69 trained laboratories participated in a sequencing EQA in which each laboratory was sent three PCR-positive samples. Laboratories produced sequence data and uploaded the
relevant data files to NIID servers for examination. All 64 laboratories performed extremely well in identifying samples 1 and 2, representing Omicron BA.1 and BA.2, respectively. Sample 3, representing a BA.1/BA.2 mixed (non-recombinant) infection, presented a different challenge. In addition to the final result, this sample was a test of the quality control processes surrounding sequencing (e.g. negative control checks, contamination checks at each preparatory step, repeat sequencing from the same sample, and so on) in order to be able to safely conclude a sample contained a mixed infection. During this process, it was observed that laboratories using the Oxford Nanopore MinION Mk1c produced random errors and missed base calls more often than those that used the Illumina iSeq 100 sequencer.

NIID continues to encourage the use of WGS at the local level to support prompt local actions and proactive surveillance, as well as the global sharing of data to platforms such as GISAID.

**SARS-CoV-2 whole genome sequencing EQA in Australia**

*Presenter: Ben Howden, Microbiological Diagnostic Unit Public Health Laboratory (MDU PHL), Centre for Pathogen Genomics, Department of Microbiology and Immunology, The University of Melbourne*

- EQA processes are important to ensure confidence in the network. There are multiple approaches available for both the ‘wet’ and the ‘dry’ component of WGS.
- EQAs represent a cornerstone in introducing new test methods, building capacity building and ensuring baseline quality.
- EQA can provide confidence in approaches and data generated, identify areas for potential improvement and assist with the validation of new testing methods.
- A workshop facilitated by the Royal College of Pathologists of Australasia (RCPA) in October 2020 identified key EQA metrics and evaluation criteria:
  1. criteria used in post-processing practice (trimming of low-quality reads, genome assemblies)
  2. the quality of reads
  3. the accuracy of lineage designation, identification and characterization
  4. the percentage genome coverage for samples with varying amounts of the virus
  5. the phylogenetic tree building capacity
  6. the de novo sequencing and genome assembly capacity.
- Confidentiality of results is key to laboratories feeling comfortable participating in the process.
- Moving forward with EQA in the Western Pacific Region:
  - Potentially useful for laboratories with established SARS-CoV-2 WGS capacity or working towards developing capacity
  - Could focus on wet laboratory, bioinformatics analysis, or both
  - A pilot programme to assess feasibility and utility likely to be a good first step
  - Could be linked to training activities.

**2.5 Plenary 4: EMPaCT step 3**

Dr Tomoya Saito introduced this session. He noted that WGS is both valuable and highly technical, requiring complex capabilities. The presentations in this session demonstrated how global mechanisms could support or facilitate the development of genomic surveillance systems to deal with the ongoing COVID-19 pandemic and prepare for future pandemics.
2.5.1 Training module of step 3  
*Presenter: Koen Hulshof, WHO Regional Office for the Western Pacific*

EMPaCT step 3 training was recommended at the inaugural EMPaCT meeting in 2021. The deliberations of the earlier plenary discussions also highlighted the importance of EMPaCT step 3 training.

Step 3 enables Member States to improve their capacity at subnational levels to investigate unusual events and to rapidly assess the transmissibility, severity and impact of SARS-CoV-2 variants in the field.

Over the past months, the WHO Regional Office, in collaboration with WHO country offices, national counterparts and partner institutes, developed a step 3 training. The training is made up of three modules and two case studies and is intended for a multidisciplinary front-line RRT staff audience. The modular design allows for adaptation to the context of Member States and different audiences. Implementation of the training will be the topic of ongoing discussions between the WHO Regional Office, WHO country offices and Member States, and is expected to start in October 2022.

Discussions following the presentation generated a lot of interest in step 3 training.

2.5.2 Monitoring of Omicron variants in Singapore  
*Presenter: Ding Yichen, National Centre for Infectious Diseases (NPHL), Singapore*

Dr Yichen presented how Singapore has been using WGS for SARS-CoV-2 surveillance and for risk assessments of different variants. Through case studies, the value of WGS was shown to have supported changes in entry requirements, in PHSM in nursing homes and in clinical care of immunocompromised patients. WGS was furthermore used to assess the severity of different variants, noting that correct interpretation of assessments can be complex due to changes in sampling strategies. Dr Yichen further elaborated on the need to adapt the sampling strategies based on a continuous review of the situation during different phases of the response. Overall, WGS, in combination with epidemiological and clinical information, has proven to be a powerful tool for detecting, monitoring and assessing different variants.

2.6 Plenary 5: Decision-making for public health

Participants highlighted the importance of WGS data for decision-making. Suggestions were made on better linking WGS data with epidemiological information as part of multi-source information for decision-making. During the session, countries shared experiences on the use of WGS data to support the calibration of public health and social measures, encourage testing in areas of concern and promote vaccination. Participants also discussed ways to sensitize policy-makers on the use of WGS data and epidemiological information to support decision-making. An example given was providing senior officials with periodical briefings containing easy-to-understand information that can be used for decision-making. To advance the WGS capacities in countries, a step-by-step approach is recommended. Capacity-building is an important area for support, focusing on improving bioinformatics capacities. Additionally, to support sharing of information to regional or global platforms for risk assessment, participants highlighted the need for standardization of sequencing methodology.

2.7 Plenary 6: Global situation of genomic surveillance
2.7.1 Global genomic surveillance strategy  
*Presenter: Gina Samaan, WHO headquarters*

The WHO Global Genomic Surveillance Strategy for Pathogens with Pandemic and Epidemic Potential 2022 aims to link and embed pathogen monitoring within broader surveillance systems, identify opportunities to strengthen and establish capacities and systems and bring partners and stakeholders together to work on a common vision. The five objectives of the strategy are to improve access to tools, strengthen the workforce, enhance data sharing, maximize connectivity, and maintain readiness. From 2021 to 2022, sequencing capability increased by 36% and data sharing by 50% globally.

2.7.2 Pathogen genome data sharing  
*Presenter: Vaseeharan Sathiyamoorthy, WHO headquarters*

Common concerns raised were country ownership of sequencing data and building trust, delays between sequencing and uploading of data, linking sequencing data with clinical and epidemiological data, equity, and access to interventions. Challenges include access and equity, capabilities, analysis, information sharing, and sustainability. In the African Region, 40 countries have developed effective sequencing capacity. One of the lessons learnt is that surveillance and lab teams need to work together in harmonizing their data for policy decisions. The South-East Asia Region had limited PCR capacity before COVID-19. During the pandemic, eight Member States have developed in-country sequencing capacity, and a regional network is available to the Member States for referral testing.

2.7.3 Experience of new variant detection in the African Region  
*Presenter: Hieronyma Nelisiwe Gumede-Moletsi, WHO Regional Office for Africa*

In the African Region, the main challenges identified were producing sequencing results within 14 days of turnaround time, limited laboratory equipment, lack of lab space dedicated to sequencing activities, high staff turnover in some countries due to competing priorities, delays in submitting sequences data to GISAID and sharing of the sequencing results.

2.7.4 Experience of new variant detection in the South-East Asia Region  
*Presenter: Dhamari Naidoo, WHO Regional Office for South-East Asia*

The WHO South-East Asia Region identified challenges with proper data linkages between PCR sample data and patient surveillance, with information sharing, with EQA programmes, with protocols for SARS-CoV-2 sequencing and with procurement and supply chain. The WHO South-East Asia Genomic Surveillance Regional Action Plan 2022–2027 was developed to enhance sequencing and surveillance, build sustainable genomic sequencing and surveillance systems, enhance rapid information and sample sharing, and improve access to tools and resources for emerging pathogens of endemic and pandemic potential. Priority activities include conducting a national baseline needs assessment to inform national action plans, strengthen genomic surveillance, enhance data analytics systems, optimize national genomic surveillance protocols and strengthen existing national quality assurance programmes in laboratory systems.

2.8  Closing session

Professor Ben Howden introduced the closing session, then offered an opportunity for Member States to comment on the conclusions and recommendations.

Dr Tamano Matsui, the responsible officer for the meeting, expressed her appreciation to the participants, especially representatives of the Members States who gave presentations and made
interventions. She thanked the temporary advisers and her colleagues from the WHO Regional Office for the Western Pacific.

Dr Babatunde Olowokure, Regional Emergency Director, WHO Regional Office for the Western Pacific, commended the meeting participants for their contributions and closed the meeting.
3. Conclusions and recommendations

Member States are encouraged to take action towards developing and strengthening access to sustainable genomic surveillance systems. The WHO Secretariat and partners are recommended to provide technical and strategic support to Member States in a coordinated way under the EMPaCT Surveillance Network.

3.1 Conclusions

(1) Genomic surveillance has proven to be a valuable public health surveillance tool to inform response decisions during the COVID-19 pandemic as part of multi-source surveillance in Member States.

- Genomic surveillance enables countries to detect, monitor and assess VOCs/VOIs and to tailor public health responses depending on the transmissibility, severity and impact of the variants.
- Current sample referral mechanisms provide resource-limited countries with genomic surveillance information to support decision-making on public health and social measures (as a part of multi-source surveillance).

(2) The seven-step approach, which incorporates the key principles of the *Asia Pacific Strategy for Emerging Diseases and Public Health Emergencies* (APSED III), can guide Member States in developing a genomic surveillance system.

- The seven-step approach offers a well-defined scope for developing a genomic surveillance system by a specified multidisciplinary workforce and cadre under appropriate governance structures.
- The seven-step approach deals with both existing and new variants of SARS-CoV-2 as well as emerging infectious diseases with pandemic potential.
- The EMPaCT Surveillance Network, facilitated by WHO, provides a practical platform for partners to contribute to system development in Member States in a coordinated way.

(3) Commitment from decision-makers is needed at national and subnational levels to implement and strengthen sustainable investments in systems and resources.

- To ensure sustainability in funding while optimizing available resources and appropriate data use for public health purposes, commitment from decision-makers and policy-makers is critical.

(4) A practical approach to building genomic sequencing laboratory capacity at public health laboratories shall be taken (Step 1).

- Being able to detect known VOCs/VOIs correctly is the first step of genomic sequencing capacity development at public health laboratories that have sequencing infrastructure.
- An external quality assessment (EQA) component in the training package will strengthen the robustness of genomic sequencing results.
- Depending on the skill level of participants and the equipment/software...
package available for genomic sequencing in each Member State, the training contents will be adjusted.

(5) Capacity to assess the transmissibility, severity and impact of circulating VOCs/VOIs is critical at national and subnational levels (Step 3).

- Coordination of laboratory, epidemiological and clinical information is critical for public health genomic surveillance and facilitates assessments of transmissibility, severity and impact of variants.
- Step 3 training to align epidemiology, clinical and laboratory staff, and to build human resource capacities for rapid response, genomics and other functions, is also critical.

(6) It is important to continue to build on the existing strong regional cooperation, technical collaboration and solidarity to prepare for future public health emergencies.

- Many countries in the Region are developing genomic sequencing capacities, and regional partners are supporting them in this work. These collaborations, in the spirit of solidarity, are crucial to building the genomic surveillance capacity of the Region to respond to current public health emergencies and prepare for future ones.

3.2 Recommendations

**Member States are encouraged to consider the following:**

1. Strengthen evidence-informed response decision-making using genomic surveillance information as a part of a multi-source surveillance system.
2. Ensure access to genomic sequencing for resource-limited countries.
3. Identify a specific multidisciplinary workforce and cadre to work on each step of the EMPaCT seven-step approach.
4. Develop a practical road map to implement the EMPaCT seven-step approach to meet country context and needs.
5. High-level advocacy to get commitment from decision-makers and policy-makers on genomic surveillance system development including ensuring sustainable funding considering country context and needs.
6. Develop a practical road map for genomic sequencing capacity development at public health laboratories to meet country context and needs.
7. Plan to have a surveillance system structure that promotes combining laboratory, epidemiological and clinical information.
8. Build capacity to assess transmissibility, severity and impact of SARS-CoV-2 variants in each Member State, including having training for rapid response teams (RRTs) based on country context and needs (national or subnational model).
9. Facilitate the sharing of genomic surveillance system information in the most ethical, equitable, efficient and effective way to support local, national and international public health responses.
The WHO Secretariat is requested to consider the following:

1. Support Member States to further strengthen genomic surveillance information as a part of multi-source surveillance to promote evidence-informed response decision-making.
2. Support resource-limited countries in ensuring access to genomic sequencing.
3. Support Member States to develop genomic surveillance systems using the EMPaCT seven-step approach in collaboration with partners.
4. Work with Member States to strengthen commitment from decision-makers and policy-makers on genomic surveillance system development including ensuring sustainable funding.
5. Coordinate with partners to develop and provide practical training packages for public health laboratories to achieve minimum skills.
6. Support the adaptation of training models (e.g. regional or national) depending on country context and needs.
7. Support Member States in adapting and rolling out the Step 3 training to meet country context and needs.
8. Coordinate, monitor and report the progress of implementation of genomic surveillance in countries and across the Region in close collaboration with Member States and partners, and harmonizing with 10-year global strategy and other related initiatives.
9. Organize the annual EMPaCT Surveillance Network meeting to share best practices and progress with Member States and partners.

Partners are encouraged to consider the following:

1. Support Member States in a coordinated way under the EMPaCT Surveillance Network.
2. Provide continuous support to resource-limited countries.
3. Support Member States in developing trainings and road maps in collaboration with WHO under the EMPaCT Surveillance Network.
4. Support Member States to advocate for commitment and sustainable funding from policy-makers.
5. Propose suitable training models for Member States depending on their needs under WHO’s coordination.
6. Support Member States in exploring opportunities for pilots and trainings on EQA.
7. Work with WHO to support Member States in developing a multidisciplinary surveillance system structure and a training module for subnational RRTs.
8. Work together efficiently and avoid duplication of efforts to utilize precious resources and make strategic investments in strengthened national and subnational systems under WHO’s coordination.
9. Contribute to the annual EMPaCT Surveillance Network meeting to share best practices and progress in supporting Member States.
## Annex 1. Programme of activities

<table>
<thead>
<tr>
<th>Time</th>
<th>Activities</th>
<th>Speaker/Moderator</th>
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<tr>
<td><strong>Day 1: Thursday, 1 September 2022</strong></td>
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<tr>
<td>10:00-10:15</td>
<td>1. Opening session</td>
<td>Dr Babatunde Olowokure</td>
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<td>1.1 Welcome remarks</td>
<td>Dr Tamano Matsui</td>
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<td>1.2 Overview of meeting and objectives</td>
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<td>1.4 Virtual group photo</td>
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<td>10:15-11:00</td>
<td>2. Plenary 1: Setting the scene</td>
<td>Professor Benjamin Howden</td>
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<td>2.1 EMPaCT seven-step approach</td>
<td>Dr Tamano Matsui</td>
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<td><em>Facilitated discussion</em></td>
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<td>11:00-12:30</td>
<td>3. Plenary 2: Country Experiences of genomic surveillance</td>
<td>Dr Eka Buadromo</td>
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<td>3.1 Country presentation</td>
<td>Dr Thilaka Chinnayah</td>
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<td><em>Facilitated discussion</em></td>
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<td>12:30-13:00</td>
<td>Mobility Break</td>
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<td>13:00-14:30</td>
<td>4. Plenary 3: Toward implementation of EMPaCT: Step 1 and 2</td>
<td>Dr Sarah Jefferies</td>
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<td>4.1 Overall training plan</td>
<td>Dr Cui Lin</td>
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<td>4.2 Country presentation</td>
<td>Dr Shilpa Iyer</td>
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<td>- Cambodia</td>
<td>Dr Satoshi Shimada</td>
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<td>4.3 External quality assessment (EQA)</td>
<td>Dr Makoto Kuroda</td>
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<td>- Japan</td>
<td>Professor Benjamin Howden</td>
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<td><em>Facilitated discussion</em></td>
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<td>14:30-15:00</td>
<td>Secretariat Meeting (only for Temporary Advisors and WHO Secretariat)</td>
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<td><strong>Day 2: Friday, 2 September 2022</strong></td>
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<td>10:00-10:15</td>
<td>Recap of day 1</td>
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<td>Time</td>
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| 10:15-11:00  | 5. Plenary 4: EMPaCT: Step 3  
5.1 Training module of Step 3  
5.2 Monitoring of Omicron variants in Singapore  
*Facilitated discussion* | Dr Tomoya Saito  
Dr Koen Hulshof  
Dr Ding Yichen |
| 11:00-12:00  | 6. Plenary 5: Decision making for public health  
*Facilitated discussion* | Dr Thilaka Chinnayah and Professor Li Mingkun |
| 12:00-12:30  | Mobility Break                                                           |                                                                              |
| 12:30-13:30  | 7. Plenary 6: Global situation on genomic surveillance  
7.1 Global genomic surveillance strategy  
7.2 Pathogen genome data sharing  
7.3 Experience of new variant detection in African Region  
7.4 Experience of new variant detection in South-East Asia Region  
*Facilitated discussion* | Dr Erik Karlsson and Dr Janice Lo  
Dr Gina Samaan  
Dr Vaseeharan Sathiyamoorthy  
Dr Hieronyma Nelisiwe Gumede-Moeletsi  
Ms Dhamari Naidoo |
| 13:30-14:00  | 8. Plenary 7: Conclusion and recommendations                              | Professor Ben Howden |
| 14:00-14:30  | 9. Closing remarks                                                         | Dr Babatunde Olowokure |
| 14:30-15:00  | Secretariat Meeting (only for Temporary Advisors and WHO Secretariat)      |                                                                              |
Annex 2. List of participants

**Australia**

Mr Torsten Seemann, Associate Professor, Lead Bioinformatician, Microbiological Diagnostic Unit Public Health Laboratory, The University of Melbourne, The Peter Doherty Institute for Infection and Immunity, Level 1, MDU PHL, 792 Elizabeth Street, Melbourne VIC 3000, telephone: + 61 456 213 900, email: t.seemann@unimelb.edu.au

Ms Siobhan St George, Epidemiologist/Assistant Director, Communicable Diseases Branch, Australian Government Department of Health, Scarborough House, Atlantic Street, Woden 2606, telephone: + 02 6289 1259, email: Siobhan.StGeorge2@health.gov.au

Dr Michel Watson, Acting Assistant Director, Office of Health Protection and Response, Department of Health, Australian Government, Sirius Building GPO Box 9848 Canberra ACT 2601, telephone: + 612 6289 8855, email: michel.watson@health.gov.au

**Brunei Darussalam**

Dr Zainun Bte Haji Zaini, Chief Scientific Officer, Department of Laboratory Services, Ministry of Health Brunei Darussalam, Jalan Menteri Besar, Muara BB3910, telephone: +673 8614266, email: zainun.zaini@moh.gov.bn

**Cambodia**

Ms Boy Chansopheap, Officer at the Medical Laboratory Services Bureau, Hospital Services Department, Ministry of Health, #80, Avenue Penn Nuoth, Boeung Kak II, ToulKork, Phnom Penh, telephone: + 855 95 858 668, email: sopheapcb@gmail.com

Mr Chin Savuth, Deputy Chief, National Public Health Laboratory, National Institute of Public Health, #80, Samdech Penn Nouth Blvd, Sangkat Boeung Kak 2, Tuol Kork District, Phnom Penh, telephone: + 855 23 966 449, email: savuth.chin@niph.org.leh

Dr Yi Sengdoeurn, Deputy Director, Communicable Disease Control Department, Ministry of Health, #80, Samdech Penn Nouth Blvd, Sangkat Boeung Kak 2 Tuol Kork District, Phnom Penh, telephone: + 855 17 670 909, email: doeurm.cdc@gmail.com

**China**

Dr Song Shuhui, Associate Professor, National Genomics Data Center, Beijing Institute of Genomics, Chinese Academy of Sciences, China National Center for Bioinformation, No.1 Beichen West Road, Chaoyang District, Beijing 100101, telephone: + 86 10 84097620, Fax: + 86 10 84097720, email: songshh@big.ac.cn

Dr Wu Zhiqiang, Professor, NHC Key Laboratory of Systems Biology of Pathogens, Institute of Pathogen Biology, Chinese Academy of Medical
Dr Yong Zhang, Researcher, Department of Poliomyelitis, National Institute for Viral Disease, Control and Prevention, China CDC, No. 155, Changbai Road, Changping District, Beijing 102206, telephone: +86 10 58900183, fax: +8610 58900184, email: zhangyong8@ivdc.chinacdc.cn

French Polynesia

Dr Van-Mai Cao-Lormeau, Director Laboratory of Research on Infectious, Vector-borne Diseases, Institut Louis Malarde, PO Box 30, 98713 Papeete, Tahiti, telephone: +689 40 416 468 / +689 89 738 718, fax: +689 40 431 590, email: mlormeau@ilm.pf

Dr Henri-Pierre Mallet, Head of Surveillance Office, Agence de Régulation de l’Action Sanitaire et Sociale, Ministry of Health, ARASS BP 2551 Papeete, Tahiti, telephone: +689 87 31 00 87, email: Henri-pierre.mallet@administration.gov.pf

Ms Anita Teissier, Research Laboratory Technician, Unit of Emerging Infectious Diseases, Laboratory of Research on Infectious, Vector-borne Diseases, Institut Louis Malarde, PO Box 30, 98713 Papeete, Tahiti, telephone: +689 40 416 435 / +689 87 290730, fax: +689 40 431 590, email: ateissier@ilm.pf

Hong Kong SAR (China)

Dr Lau Ka Yee Chloe, Medical & Health Officer, Respiratory Disease Section, Communicable Disease Branch, Centre for Health Protection, Department of Health, Centre for Health Protection, 147C Argyle Street, Kowloon, telephone: +2125 2221, fax: +2711 0927, email: mo_rds1@dh.gov.hk

Dr Tsang Ka Lun, Scientific Officer (Medical), Public Health Laboratory Service Branch, Centre for Health Protection, Department of Health, Public Health Laboratory Centre, 382 Nam Cheong Street, Shek Kip Mei, telephone: +852 2319 8278, fax: +852 2776 1446, email: alan_kl_tsang@dh.gov.hk

Mr Yip Chi Wai, Scientific Officer (Medical), Public Health Laboratory Service Branch, Centre for Health Protection, Department of Health, Public Health Laboratory Centre, 382 Nam Cheong Street, Shek Kip Mei, telephone: +852 2319 8546, fax: +852 2776 0344, email: so_micro2@dh.gov.hk

Japan

Dr Makoto Kuroda, Director, Pathogen Genomics Center, National Institute of Infectious Diseases, 1-23-1 Toyama, Shinjyuku-ku, Tokyo 162-8640, telephone: +81 3 5285 1111, fax: +81 3 5285 1166, email: makokuro@niid.go.jp
Dr Motoi Suzuki, Director, Center for Surveillance, Immunization and Epidemiologic Research, National Institute of Infectious Diseases, 1-23-1 Toyama, Shinjyuku-ku, Tokyo 162-86 40, telephone: +81 3 5285 1111, fax: +81 3 5285 1129, email: mosuzuki@niid.go.jp

Dr Tadaki Suzuki, Director, Department of Pathology, National Institute of Infectious Diseases, 1-23-1 Toyama, Shinjyuku-ku, Tokyo 162-8640, telephone: +81 3 5285 1111, fax: +81 3 5285 1189, email: tksuzuki@nih.go.jp

Lao People’s Democratic Republic

Dr Souphatsone Houathongkham, Deputy Chief, Epidemiology Division, National Center for Laboratory and Epidemiology, Ministry of Health, Ban Thatkhao, Sisattanack district, Rue Simeuang, Vientiane, telephone: + 85620 56551988, email: spsncle@gmail.com

Dr Viengsavanh Kitthiphong, Chief, Surveillance Division, Ministry of Health, Simuang Road, Sisatanak District, Vientiane, telephone: + 856 21 840117, email: fcfornai@gmail.com

Dr Bouaphanh Khamphaphongphane, Deputy Director, National Centre for Laboratory and Epidemiology, Ministry of Health, Ban Thatkhao, Sisattanack district, Rue Simeuang, Vientiane, telephone: +856 20 55036006, email: bkhamphaphongphane@gmail.com

Dr Somphavanh Somlor, Scientist, Arbovirus and Emerging Viral Diseases, Laboratory, Institute Pasteur du Laos, Samsenthai Road, Ban Kao-gnot, PO Box 3560, Vientiane, telephone: + 856 20 55535644, fax: + 856 21 28 53 26, email: s.somlor@pasteur.la

Dr Dalouny Xayavong, Technical Staff, Laboratory Division, National Center for Laboratory and Epidemiology, Ministry of Health, Ban Thatkhao, Sisattanack district, Rue Simeuang, Vientiane, telephone: +85620 28149198, email: Din_xyv@hotmail.com

Malaysia

Madam Rehan Shuhada binti Abu Bakar, Science Officer (Microbiology), Disease Virology Molecular, National Public Health Laboratory, Ministry of Health Malaysia, Lot 1853, KG. Melayu Sungai Buloh, 47000 Sungai Buloh, Selangor, telephone: + 60162339812, email: rehanshuhada@gmail.com

Dr Mohd Ishtiaq bin Anasir, Research Officer, Infectious Disease Research Centre/Virology Unit, Institute for Medical Research, Ministry of Health Malaysia, National Institutes of Health, Jalan Selia Murni U13/52 Seksyen U13 Setia Alam, 40170 Shah Alam, Selangor, telephone: +60168277166, email: ishtiaq.anasir@gmail.com
Madam Tengku Rogayah binti Tengku Abdul Rashid, Research Officer, Virology Unit, Institute for Medical Research, Ministry of Health Malaysia, Level 2, Block C7, National Institute of Health, 40170 Shah Alam, Selangor, telephone: +60333628942, email: tg_rogayah@moh.gov.my

Dr Wan Noraini Binti Wan Mohamed Noor, Head of Surveillance Sector, Disease Control Division, Ministry of Health Malaysia, Level 6, Block E10, Complex E, 62590 Putrajaya, telephone: +60388834119 / +60192202637, fax: + 60388886277, email: drwnoraini@moh.gov.my

Mongolia
Dr Darmaa Badarch, Head of Virology Laboratory, National Center for Communicable Diseases, Ministry of Health, Nam Yan Ju Street, Bayanzurkh District, 13th Horoolol NCCD Campus, Ulaanbaatar, telephone: + 976 99754824, email: darmaanicmn@gmail.com

Dr Tsogzolmaa Ganbold, Scientist, National Center for Communicable Diseases, Ministry of Health, Nam Yan Ju Street, Bayanzurkh District, 13th Horoolol NCCD Campus, Ulaanbaatar, telephone: +976 91116139, email: Tsogi001@gmail.com

Mr Baatar Gantsooj, Data Manager, National Influenza Center, National Center for Communicable Diseases, NCCD Campus, Bayanzurkh District, Ulaanbaatar, telephone: +976 91998239, email: ganbbbb@gmail.com

Dr Baigalmaa Jantsansengee, Deputy Director, Communicable Disease Surveillance, National Center for Communicable Diseases, NCCD Campus, Bayanzurkh District, Ulaanbaatar, telephone: +976 99080218, email: j.baigalmaa@nccd.gov.mn

New Zealand
Dr Miles Benton, Bioinformatics Lead Human Genomics, Environment and Health, Institute of Environmental Health and Science Research, Kenepuru Science Centre, 34 Kenepuru Drive, Porirua 5022, telephone: +64 212472229, email: miles.benton@esr.cri.nz

Ms Judy Bocacao, Scientist, Clinical Virology, Institute of Environmental Science and Research, 66 Ward St, Wallaceville, Upper Hutt, Telephone: +02102412926, email: judy.bocacao@esr.cri.nz

Dr Joep de Ligt, Lead Bioinformatics & Genomics, Institute of Environmental Science and Research Limited, Kenepuru Science Centre, 34 Kenepuru Drive, Kenepuru, Porirua 5022, telephone: +027 218 8525, email: joepio@gmail.com

Philippines
Ms Lei Lanna Dancel, Supervising Science Research Specialist, Laboratory Manager, Molecular Biology Laboratory, Research Institute for Tropical Medicine, 9002 Research Drive, Filinvest Corporate City, Alabang 1781, Muntinlupa, telephone: +09985313596, email: leilannadancel.ritmmbi@gmail.com
Mr Francisco Gerardo Polotan, Science Research Specialist II, Bioinformatics Specialist, Laboratory Research Division, Molecular Biology Laboratory, Research Institute for Tropical Medicine, 9002 Research Drive, Filinvest Corporate City, Alabang 1781, Muntinlupa, telephone: +632 88177281, email: fgmpolotan@gmail.com

Dr Maria Rosario Singh-Vergeire, Undersecretary of Health, Public Health Services Team, Department of Health, San Lazaro Compound, Tayuman, Sta. Cruz, Manila, telephone: +632 86517800, email: phstusec@doh.gov.ph

Ms Arianne Zamora, Supervising Health Programme Officer, Epidemiology Bureau, Department of Health, San Lazaro Compound, Tayuman, Sta. Cruz, 1003 Manila, telephone: +09279852264, email: aazamora@doh.gov.ph

**Republic of Korea**

Dr Kim Heui Man, Staff Scientist, Division of Emerging Infectious Diseases, Bureau of Infectious Disease Diagnosis Control, Korea Disease Control and Prevention Agency, 187 Osongsaengmyeong2-ro, Osong-eup, Heungdeok-gu, Cheongju-si 28159, telephone: + 82 43 7198178, fax: + 82 43 7198229, email: animal80@korea.kr

Dr Eun Jin Kim, Director, Division of Emerging Infectious Diseases, Bureau of Infectious Disease Diagnosis Control, Korea Disease Control and Prevention Agency, 187 Osongsaengmyeong2-ro, Osong-eup, Heungdeok-gu, Cheongju-si 28159, telephone: + 82 43 7198140, fax: + 82 43 7198229, email: ekim@korea.kr

Dr Il-Hwan Kim, Staff Scientist, Division of Emerging Infectious Diseases, Korea Disease Control and Prevention Agency, 187 Osongsaengmyeong2-ro, Osong-eup, Heungdeok-gu, Cheongju-si 28159, telephone: + 82 43 7198141, fax: + 82 43 7198229, email: ilhwan98@korea.kr

**Tonga**

Dr Luke Latu Huni, Medical Officer, Laboratory, Ministry of Health, Tofoa, Tongatapu, Nuku’alofa, email: luke.huni18@gmail.com

**Viet Nam**

Dr Cao Minh Thang, Vice-head, Microbiology & Immunology Department, Pasteur Institute, Ho Chi Minh City, 167 Pasteur St., District 3, Ho Chi Minh, email: tminhcao@gmail.com

Dr Hoang Vu Mai Phuong, Head of Department of Virology, National Institute of Hygiene and Epidemiology, Ministry of Health, 1 Yersln Street, Hal Ba Trung District, Hanoi, telephone: +0904160430, email: hvmp@nihe.org.vn
1. Temporary advisers

Dr Eka Buadromo, Senior Laboratory Advisor, Pacific Public Health Surveillance Network—Pacific Lab Net SPC, SPC Narere Campus, Private Mail Bag, Suva, Fiji, telephone: +679 3315-600, fax: +679 337 8598, email: ekabi@spc.int

Dr Cui Lin, Senior Principal Scientific Officer, National Public Health Laboratory, National Centre for Infectious Diseases, 16 Jln Tan Tock Seng, Singapore 308442, Republic of Singapore, telephone: +65 6357 7301, fax: +65 6251 5829, email: CUI_Lin@moh.gov.sg

Professor Ben Howden, Director, Microbiological Diagnostic Unit Public Health Laboratory (MDU PHL), Department of Microbiology and Immunology, The University of Melbourne, Level 1, 792 Elizabeth Street, 3000 Melbourne, Australia, telephone: +61 402 172 725, email: Bhowden@unimelb.edu.au

Dr Sarah Jefferies, Public Health Medicine Specialist, Health Intelligence Group, Institute of Environmental Science and Research, Limited (ESR) Kenepuru Science Centre, 34 Kenepuru Drive, Kenepuru Porirua 5022, New Zealand, telephone: +64 277048696, email: Sarah.Jefferies@esr.cri.nz

Dr Erik Karlsson, Deputy Head, Virology Unit, Director, National Influenza Center of Cambodia and WHO H5 Reference Laboratory Coordinator, WHO COVID-19 Global Referral Laboratory, Institut Pasteur du Cambodge, 5 Monivong Blvd., PO Box 983, Phnom Penh, Cambodia, telephone: +85570297804, email: ekarlsson@pasteur-kh.org

Professor Li Mingkun, Principal Investigator, CAS Key Laboratory of Genomic and Precision Medicine, Beijing Institute of Genomics, Chinese Academy of Sciences China National Center for Bioinformation, No.1 Beichen West Road, Chaoyang District, Beijing 100101, China, telephone: + 86 10 84097716, fax: + 86 10 4097720, email: limk@big.ac.cn
Dr Janice Lo, Microbiology Division, Department of Health, 9/F Public Health Laboratory Centre, 382 Nam Cheong Street, Shek Kip Mei, Kowloon, Hong Kong SAR, telephone: +852 2319 8254, fax: +852 2776 2427, email: ken.hl_ng@dh.gov.hk

Dr Tomoya Saito, Director, Center for Emergency Preparedness and Response, National Institute of Infectious Diseases, Toyama 1-23-1, Shinjyuku, Tokyo 162-8640, Japan, telephone: +81 3 5285 1111, email: saitot16@niid.go.jp

3. Observers/Representatives

**COVID-19 Genomics UK Consortium**

Professor Alistair Darby, Deputy Director, University of Liverpool, COVID-19 Genomics UK Consortium, University of Liverpool, Centre for Genomic Research, Liverpool, telephone: +44 754 715 6668, fax: +44 151 795 4410, email: Alistair.Darby@liverpool.ac.uk

Professor Darren Smith, Deputy Director, Northumbria University, Applied Sciences, Newcastle, COVID-19 Genomics UK Consortium, University of Liverpool, Centre for Genomic Research, Liverpool, telephone: +44 0191 243 7730, email: darren.smith@northumbria.ac.uk

**European Centre for Disease Prevention and Control**

Dr Theresa Enkirch, Microbiology Expert, Microbiology and Molecular Surveillance, European Centre for Disease Prevention and Control, Gustav III:s Boulevard 40, 169 73 Solna, Sweden, telephone: +46 0 70 5659292, fax: + 46 08 58601001, email: Theresa.Enkirch@ecdc.europa.eu

**Korea Disease Control and Prevention Agency**

Dr Jeong-Min Kim, Staff Scientist, Division of Emerging Infectious Diseases, Bureau of Infectious Disease Diagnosis Control, Korea Disease Control and Prevention Agency, 187 Osongsaengmyeong2-ro, Osong-eup, Heungdeok-gu, Cheongju-si 28159, telephone: + 82 43 7198143, fax: + 82 43 7198229, email: jmkim97@korea.kr

Dr Ae Kyung Park, Staff Scientist, Division of Emerging Infectious Diseases, Korea Disease Control and Prevention Agency, 187 Osongsaengmyeong2-ro, Osong-eup, Heungdeok-gu, Cheongju-si 28159, telephone: + 82 43 7198146, email: parkak1003@gmail.com

Dr Jee Eun Rhee, Deputy Director, Division of Emerging Infectious Diseases, Bureau of Infectious Disease Diagnosis Control, Korea Disease Control and Prevention Agency, 187 Osongsaengmyeong2-ro, Osong-eup, Heungdeok-gu, Cheongju-si 28159, telephone: +82 43 7198220, fax: +82 43 7198229, email: jerhee001@korea.kr
<table>
<thead>
<tr>
<th>Ministry of Health Lao People’s Democratic Republic</th>
<th>Mr Sinakhone Xayadeth, Lab Technical Staff, National Center for Laboratory and Epidemiology Ministry of Health, Km 3 Thadeua Road, Thaphalanxai Village, Sisattanak District, Vientiane, telephone: + 856 20 59546444, email: <a href="mailto:xsinakhone@gmail.com">xsinakhone@gmail.com</a></th>
</tr>
</thead>
<tbody>
<tr>
<td>Victorian Infectious Diseases Reference Laboratory</td>
<td>Professor Deborah Williamson, Director of Microbiology, Royal Melbourne Hospital, Deputy Director, Microbiological Diagnostic Unit, Public Health Laboratory, Dame Kate Campbell Fellow, University of Melbourne, The Peter Doherty Institute for Infection and Immunity, 792 Elizabeth Street, Melbourne, Victoria, Australia, telephone: + 61 0 3 8344 5470, email: <a href="mailto:deborah.williamson@unimelb.edu.au">deborah.williamson@unimelb.edu.au</a></td>
</tr>
<tr>
<td>WHO Regional Office for the Western Pacific</td>
<td>Dr Chin-Kei Lee, Acting Regional Emergencies Director, WHO Health Emergencies Programme, and Director, Division of Health Security and Emergencies, World Health Organization, Regional Office for the Western Pacific, United Nations Avenue, corner of Taft Avenue, Manila, 1000 Philippines, telephone: +86 10 65327190, email: <a href="mailto:LeeC@who.int">LeeC@who.int</a> Dr Tamano Matsui, Responsible Officer, Programme Area Manager, Health Emergency Information and Risk Assessment, WHO Health Emergencies Programme, World Health Organization, Regional Office for the Western Pacific, United Nations Avenue, corner of Taft Avenue, Manila, 1000 Philippines, telephone: +63 2 85289944, email: <a href="mailto:matsuit@who.int">matsuit@who.int</a> Ms Dominique Dela Cruz, Consultant (Laboratory), Health Services Delivery Pillar, COVID-19 Incident Management Support Team, World Health Organization, Regional Office for the Western Pacific, United Nations Avenue, corner of Taft Avenue, Manila, 1000 Philippines, telephone: +63 956 912 0212, email: <a href="mailto:delaj@who.int">delaj@who.int</a> Dr Sophie Dennis, Consultant, Country Health Emergency Preparedness, WHO Health Emergencies Programme, World Health Organization, Regional Office for the Western Pacific, United Nations Avenue, corner of Taft Avenue, Manila, 1000 Philippines, telephone: +63 927 353 1105, email: <a href="mailto:dennis@who.int">dennis@who.int</a> Dr Roger Evans, Laboratory Virologist, Measles and Rubella Laboratory Coordinator, Vaccine-Preventable Diseases and Immunization, Division of Programmes for Diseases Control, World Health Organization, Regional Office for the Western Pacific, United Nations Avenue, corner of Taft Avenue, Manila, 1000 Philippines, telephone: +63 2 8 5289037, email: <a href="mailto:revans@who.int">revans@who.int</a></td>
</tr>
</tbody>
</table>

### 4. Secretariat

---
Ms Varja Grabovac, Scientist, Regional Laboratory Coordinator for Vaccine Preventable Diseases, Vaccine-Preventable Diseases and Immunization, Division of Programmes for Diseases Control, World Health Organization, Regional Office for the Western Pacific, United Nations Avenue, corner of Taft Avenue, Manila, 1000 Philippines, telephone: +63 2 8 5289747, email: grabovacv@who.int

Dr Shilpa Iyer, Consultant (Laboratory), Health Services Delivery Pillar, COVID-19 Incident Management Support Team, World Health Organization, Regional Office for the Western Pacific, United Nations Avenue, corner of Taft Avenue, Manila, 1000 Philippines, telephone: +353 85 8147108, email: iyers@who.int

Mr Jan-Erik Larsen, Technical Officer, Emergency Operation, WHO Health Emergencies Programme, World Health Organization, Regional Office for the Western Pacific, United Nations Avenue, corner of Taft Avenue, Manila, 1000 Philippines, telephone: +632 85289362, email: larsenj@who.int

Mr Benjamin George Lilley, Technical Officer, Legislation and Regulation, Health Law and Ethics, Division of Health Systems and Services, World Health Organization Regional Office for the Western Pacific, United Nations Avenue, corner of Taft Avenue, Manila, 1000 Philippines, telephone: +63 928 501 2071, email: lilleyb@who.int

Dr Angela Merianos, Epidemiologist (Risk Assessment), Health Emergency Information and Risk Assessment, WHO Health Emergencies Programme World Health Organization, Regional Office for the Western Pacific, United Nations Avenue, corner of Taft Avenue, Manila, 1000 Philippines, telephone: +63 2 8 5289784, email: merianosa@who.int

Dr Sangjun Moon, Medical Officer, Health Emergency Information and Risk Assessment, WHO Health Emergencies Programme, World Health Organization Regional Office for the Western Pacific, United Nations Avenue, corner of Taft Avenue, Manila, 1000 Philippines, telephone: +632 85289862, email: smoon@who.int

Mr Nguyen Phuong Nam, Technical Officer, Pandemic Influenza Preparedness Infectious Hazard Management, WHO Health Emergencies Programme, World Health Organization, Regional Office for the Western Pacific, United Nations Avenue, corner of Taft Avenue, Manila, 1000 Philippines, telephone: +632 85289783, email: nguyenp@who.int

Dr Hiromasa Okayasu, Coordinator, Healthy Ageing Data Strategy and Innovation Team, World Health Organization, Regional Office for the Western Pacific, United Nations Avenue, corner of Taft Avenue, Manila, 1000 Philippines, telephone: +63 2 8 5289752, email: okayasuhi@who.int
Dr Darwin Operario, Consultant (Laboratory), Health Services Delivery Pillar, COVID-19 Incident Management Support Team, World Health Organization, Regional Office for the Western Pacific, United Nations Avenue, corner of Taft Avenue, Manila, 1000 Philippines, email: operariod@who.int

Mr Asaeli Raikabakaba, Technical Officer, Division of Pacific Technical Support (DPS), World Health Organization, Level 4 Provident Plaza One Downtown, Boulevard 33 Ellery Street, Suva, Fiji, email: raikabakabaa@who.int

WHO Cambodia
Dr Sarika Patel, Technical Officer, Division of Health Security and Emergencies, World Health Organization, Country Office for Cambodia, No. 61-64, Preah Norodom Blvd. (corner Street 306), Sangkat Boeung Keng Kang I, Khan Chamkamorn, Phnom Penh, email: patelsa@who.int

WHO Fiji
Mr Sean Casey, Acting Team Coordinator, Pacific Health Security & Communicable Diseases, Pacific Health Cluster Coordinator, Emergency Medical Team Focal Point, Division of Pacific Technical Support (DPS), World Health Organization, Level 4 Provident Plaza One Downtown, Boulevard 33 Ellery Street, Suva, telephone: 679 717 1583, email: scasey@who.int
Dr Karen Johnson, Division of Pacific Technical Support (DPS), World Health Organization, Level 4 Provident Plaza One Downtown, Boulevard 33 Ellery Street, Suva, email: kjohnson@who.int
Ms Katri Maria Kontio, Technical Officer, Division of Pacific Technical Support (DPS), World Health Organization, Level 4 Provident Plaza One Downtown, Boulevard 33 Ellery Street, Suva, telephone: 679 3234100, email: kkontio@who.int

WHO Lao People’s Democratic Republic
Ms May Chiew, Technical Officer (Epidemiologist), WHO Health Emergencies Programme, World Health Organization, Country Office for Lao People’s Democratic Republic, 125 Saphanthong Road, Unit Ban Saphansthongtai, Sisattanak District, Vientiane, telephone: +856 20 55914975, email: chiewm@who.int
Ms Pakapak Ketmayoon, Technical Officer, WHO Health Emergencies Programme, World Health Organization, Country Office for Lao People’s Democratic Republic, 125 Saphanthong Road, Unit Ban Saphansthongtai, Sisattanak District, Vientiane, email: ketmayoonp@who.int
Dr Manilay Phengxay, Technical Officer, WHO Health Emergencies Programme, World Health Organization, Country Office for Lao People’s Democratic Republic, 125 Saphanthong Road, Unit 5 Ban Saphansthongtai, Sisattanak District, Vientiane, telephone: +856 21353902, email: phengxaym@who.int
Dr Sonesavanh Phimmasine, Technical Officer, WHO Health Emergencies Programme, World Health Organization, Country Office for Lao People’s Democratic Republic, 125 Saphanthong Road, Unit 5 Ban Saphanthongtai, Sisattanak District, Vientiane, telephone: +856 20 22238955, email: phimmasines@who.int

WHO Malaysia
Professor Chee Hui Yee, Consultant, Laboratory Technical Officer, Molecular Virology, World Health Organization, Country Office for Malaysia, 4th Floor Prima 8, Block 3508 Jalan, Teknokrat 6, 63000 Cyberjaya Selangor, telephone: +6012 2215935, email: cheeh@who.int

WHO Mongolia
Dr Bayarzaya Artbazar, Consultant, Laboratory, WHO Health Emergencies Programme, World Health Organization, Country Office for Mongolia, Ministry of Health, Government Building No. 8 Ulaanbaatar, telephone: +976 99061779, email: bayarzaya@gmail.com

Dr Dulamragchaa Buyanbaatar, Special Services Agreement, Health emergencies, WHO Health Emergencies Programme, World Health Organization, Country Office for Mongolia, Ministry of Health, Government Building No. 8, Ulaanbaatar, telephone: +976 95955941, email: buyanbaatardl@who.int

Dr Gerelmaa Danzan, Special Services Agreement, Laboratory and Logistics, WHO Health Emergencies Programme, World Health Organization, Country Office for Mongolia, Ministry of Health, Government Building No. 8, Ulaanbaatar, telephone: +976 95929696, email: danzang@who.int

Dr Ariuntuya Ochirpurev, Technical Officer, WHO Health Emergencies Programme, World Health Organization, Country Office for Mongolia, Ministry of Health Government Building No. 8, Ulaanbaatar, telephone: +976 99038010, email: ochirpureva@who.int

WHO Philippines
Mr Juan Paolo Tonolete, Technical Officer, Essential Medicines, World Health Organization, Country Office for the Philippines, Ground Floor Building 3 Department of Health, San Lazaro Compound, Rizal Avenue, Sta. Cruz, Manila, telephone: +63 998 960 1729, email: tonoletej@who.int

WHO Papua New Guinea
Ms Sophea Aing, National Consultant (Laboratory), World Health Organization, Country Office for Papua New Guinea, 4th Floor, AOPI CENTRE, Waigani Drive, Port Moresby, email: aings@who.int

Ms Theresa Palou, Technical Officer, Laboratory System Strengthening, World Health Organization, Country Office for Papua New Guinea, 4th Floor, AOPI CENTRE, Waigani Drive Port Moresby, email: paloujtheresa@gmail.com

Ms Leonie Ruape, Technical Officer Laboratory, World Health Organization, Country Office for Papua New Guinea, 4th Floor AOPI CENTRE, Waigani Drive, Port Moresby, email: ruapel@who.int
<table>
<thead>
<tr>
<th>Country</th>
<th>Contact Person</th>
<th>Position/Role</th>
<th>Address/Location</th>
<th>Telephone/Email</th>
</tr>
</thead>
<tbody>
<tr>
<td>WHO Solomon Islands</td>
<td>Dr Simon Burggraaf</td>
<td>Technical Officer, Vaccine Preventable Diseases and Covid-19 Response</td>
<td>World Health Organization, Country Office for Solomon Islands, Ministry of Health Bldg., Chinatown, Honiara</td>
<td><a href="mailto:burggraafs@who.int">burggraafs@who.int</a></td>
</tr>
<tr>
<td>WHO Tonga</td>
<td>Dr Yutaro Setoya</td>
<td>Technical Officer, World Health Organization</td>
<td>Country Liaison Office for the Kingdom of Tonga, Ministry of Health, Nuku’alofa</td>
<td><a href="mailto:setoyay@who.int">setoyay@who.int</a></td>
</tr>
<tr>
<td>WHO Vanuatu</td>
<td>Dr Philippe Guyant</td>
<td>Medical Officer, World Health Organization</td>
<td>Country Office for Vanuatu, MOH Iatika Complex, P.O Box 177, Port Vila</td>
<td><a href="mailto:guyantp@who.int">guyantp@who.int</a></td>
</tr>
<tr>
<td>WHO Viet Nam</td>
<td>Dr Do Hien</td>
<td>Epidemiologist, Disease Control and Health Emergencies Team</td>
<td>World Health Organization, Country Office for Viet Nam, 304 Kim Ma Street, Hanoi</td>
<td><a href="mailto:doh@who.int">doh@who.int</a></td>
</tr>
<tr>
<td></td>
<td>Dr Otsu Satoko</td>
<td>Team Leader, Disease Control and Health Emergencies Team</td>
<td>World Health Organization, Country Office for Viet Nam, 304 Kim Ma Street, Hanoi</td>
<td><a href="mailto:otsus@who.int">otsus@who.int</a></td>
</tr>
<tr>
<td></td>
<td>Dr Phuc Nguyen Thi</td>
<td>Technical Officer (ESR), Disease Control and Health Emergencies Team</td>
<td>World Health Organization, Country Office for Viet Nam, 304 Kim Ma Street, Hanoi</td>
<td><a href="mailto:phucn@who.int">phucn@who.int</a></td>
</tr>
<tr>
<td>WHO Regional Office for the Americas</td>
<td>Dr Jairo Mendez Rico</td>
<td>Advisor, Viral Diseases, Health Emergencies Department</td>
<td>The World Health Organization, Regional Office for the Americas / Pan American Health Organization (AMRO/PAHO), 525, 23rd Street, N.W. Washington, DC 20037, U.S.A.,</td>
<td><a href="mailto:ricoj@paho.org">ricoj@paho.org</a></td>
</tr>
<tr>
<td>WHO Regional Office for Europe</td>
<td>Dr Marco Marklewitz</td>
<td>Laboratory Expert, Incident Management Support Team</td>
<td>WHO Health Emergency Programme, World Health Organization Regional Office for Europe (EURO), UN City, Marmorvej 51, DK-2100 Copenhagen Ø, Denmark</td>
<td><a href="mailto:marklewitzm@who.int">marklewitzm@who.int</a></td>
</tr>
<tr>
<td>WHO Regional Office for South-East Asia</td>
<td>Ms Dhamari Naidoo</td>
<td>Public Health Laboratory Scientist, WHO Health Emergencies Programme</td>
<td>World Health Organization, Regional Office for South-East Asia (SEARO), World Health House, Indraprastha Estate, Mahatma Gandhi Road, New Delhi 110002 India</td>
<td><a href="mailto:naidood@who.int">naidood@who.int</a></td>
</tr>
</tbody>
</table>
Dr Mark Perkins, Scientist, Emerging Diseases and Zoonoses, Global Infectious Hazard Preparedness, WPE Emergency Preparedness, Headquarters, World Health Organization, Avenue Appia 20, 1211 Geneva 27, Switzerland, telephone: +41 79 2011369, email: mailto:perkinsm@who.int

Dr Wenqing Zhang, Head, Global Influenza Programme, Global Infectious Hazard Preparedness, Health Emergency Preparedness, Headquarters, World Health Organization, Avenue Appia 20, 1211 Geneva 27, Switzerland, telephone: +41 22 7914282, email: mailto:zhangw@who.int