PROTECTING THE **PEOPLE OF SINGAPORE** FROM INFECTIOUS DISEASES

National Centre for Infectious Diseases

YEARBOOK 2022

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VISION

Strong, trusted and united in keeping Singapore safe from infectious diseases

MISSION

Protecting the people of Singapore from infectious diseases

CORE VALUES

Nurturing
We foster growth within a safe and supportive environment

Compassion & Collaboration
We care for everyone and work with all

Integrity & Innovation
We do the right things and embrace creativity

Dedication
We are ready to respond anytime

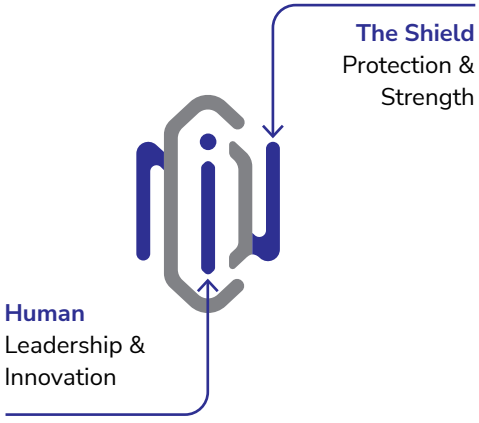
ABOUT US

In the last 20 years, the world has seen outbreaks from Nipah and SARS to Ebola and Zika. The threat of emerging infectious disease outbreaks is real. To combat infectious diseases at a national level, the National Centre for Infectious Diseases (NCID) was conceived. NCID is the result of years of hard work to build our capabilities to provide the best patient care and safeguard Singapore in an event of an outbreak.

The 330-bed purpose-built facility is designed to strengthen Singapore's capabilities in infectious disease management and prevention. NCID houses clinical services, public health, research, training and education, and community engagement functions within one overarching structure.

In addition to the clinical treatment of infectious diseases and outbreak management, the expanded roles and functional units of NCID include the Infectious Disease Research and Training Office, the National Public Health Laboratory, the National Public Health and Epidemiology Unit, the Antimicrobial Resistance Coordinating Office, and the national public health programmes for human immunodeficiency virus (HIV) and tuberculosis.

With its state-of-the-art facilities and comprehensive clinical and public health capabilities in infectious disease prevention, control, and management, NCID looks forward to playing a leading local, regional and global role in protecting the health of Singaporeans and global citizens.



The logo of the National Centre for Infectious Diseases is represented by a shield with people at the centre. It is formed from its acronym NCID with N, C, D making up the shield which stands for protection and strength. The character "I" in the middle represents the human element, synonymous with leadership and innovation. Overall, the logo amplifies NCID's role of protecting the nation from infectious diseases.

FOREWORD BY

PROFESSOR LEO YEE-SIN

EXECUTIVE DIRECTOR,
NATIONAL CENTRE FOR INFECTIOUS DISEASES

We started 2022 challenged by the first wave of COVID-19 cases brought about by the Omicron strain, specifically the BA.1 and BA.2 subvariants. The number of cases reported nationally peaked at 26,032 on 22 February. The staggering number of cases were experienced alongside the national call for the population to take the first booster dose also known as the third dose. Indeed, our data demonstrated that three doses of COVID-19 mRNA vaccine was required to retain substantial protection against severe disease for COVID-19 and against the Omicron variant, particularly for people above 65 years old.

We observed a change in disease characteristics when comparing Omicron with the preceding Delta wave. On the clinical side, we saw fewer severe cases of COVID-19, defined as cases requiring supplementary oxygen or intensive care or resulting in death. This supported the observations that a significant proportion of patients hospitalised for other primary conditions had COVID-19 concurrently. Nonetheless, these patients had to be isolated adding to the strain for beds and contributed to the demand for isolation facilities nation-wide. These factors, in combination, led to a drastic change in national policies – from housing all COVID-19 cases in acute hospitals, to setting up community treatment and isolation facilities, and setting up of the Home Recovery Programme with telemedicine. The continuous quest to study the evolution of SARS-CoV-2 and the changing patterns of clinical manifestations allowed NCID to provide evidence supporting this change in national strategy in the management of COVID-19 cases. NCID also provided consultation and training to the community of healthcare practitioners.

Singapore experienced two more waves due to the Omicron subvariants, BA.4 and BA.5 in July and XBB in October and November. We saw progressive enhancement of immune evasive properties. XBB exhibited the greatest immune evasive capability that rendered available monoclonal antibodies regimens ineffective and reduced vaccine effectiveness in preventing infection, although vaccine effectiveness against severe illness remained reasonably sustained. SARS-CoV-2 will continue to pose challenges by constantly evolving to adapt to humans. It will likely take a similar path to become like the four circulating human seasonal coronaviruses. NCID will continue in its role in leading clinical management of the COVID-19 cases.

The threat of infectious disease outbreaks remains a concern. Singapore, an open economy with a large number of international travellers, saw cases of mpox in June linked to the multi-country outbreak. In 2022, NCID saw over 45 suspected mpox cases and Singapore had 19 confirmed cases of mpox. With our open borders as a trade and travel hub, it is inevitable that the import of emerging infectious diseases remains an ongoing threat, which resulted in the cases of mpox here. The national strategies need to be further strengthened given the increasing frequencies and uncertainties of the nature of the next emerging infection.

Despite dealing with COVID-19, we maintained the operations of other public health programmes at NCID. The national programmes for tuberculosis (TB) and human immunodeficiency virus (HIV) remained accessible to patients even during the pandemic, with continuing efforts on early screening, prevention, and facilitation of treatment safely. Encouragingly, there had been a small drop in TB resident incidence rates in 2022 and HIV testing volume and clinical services had also returned to pre-COVID levels.

A cluster of seven active TB cases was found among persons living and working in Block 2 Jalan Bukit Merah. Routine contact tracing revealed a common link among the cases, that they were staying in the same geographical location. This link was then confirmed by whole genome sequencing. As a precautionary

measure, the National Tuberculosis Programme organised both on-site and off-site TB screening for all residents, workers, and former residents and tenants at the affected block from 27 May to 10 August 2022. With support from the People's Association and to encourage uptake of the screening, we engaged residents and tenants to participate in the free TB screening.

Research, training and education form a vital part of national preparedness and defence against the threat of emerging infections. In 2022, our researchers received more than $7 million in grants to conduct infectious disease research and NCID has also published more than 120 research publications with the bulk on COVID-19. NCID initiated 26 new research studies and there are currently more than 120 on-going research studies spanning areas such as antimicrobial resistance, respiratory tract infection, vector borne diseases, TB, sexually transmitted infections etc. Through NCID's research, we also supported Singapore's strategy in the management of COVID-19. For example, our research showed that while the Omicron variant is more transmissible, infected individuals carry a lower viral load and generally recover faster. Singapore then reduced the isolation period for fully vaccinated individuals and children under 12 years old from 10 days to 7 days. Encouragingly, our research on COVID-19 has also been referenced by international bodies such as World Health Organization (WHO) and US Centers for Disease Control and Prevention, a testimony that our research has impacted clinical practice guidelines or influenced healthcare policies.

In the area of training and education, we conducted over 80 activities in 2022 and engaged more than 4,000 participants across healthcare institutions, public agencies, non-governmental organisations and schools. These activities covered outbreak training and courses for both local and overseas audience and professional courses on topics such as antimicrobial resistance, dengue and HIV. In the area of public education and community outreach, we connected with audiences such as students through talks and engagement activities. A Memorandum of Understanding (MoU) was also inked with Imperial College London to formalise a mutual commitment to a deeper partnership in research, education and training.

NCID's experience thus far underscores the importance of pandemic preparedness in preparation for Disease X, taking the lessons learnt from COVID-19 in evidence-based decision making. NCID being the administrative host of the Programme for Research in Epidemic Preparedness and REsponse (PREPARE), which was launched by Minister for Health Mr Ong Ye Kung in November 2022, has the advantage of being a close partner. Under the oversight of Ministry of Health, PREPARE will support and strengthen Singapore's key research capabilities, translational platforms, and expertise to develop tools, methods and products that can be tapped on to detect, respond to, and contain future infectious disease threats. NCID, as the administrative host, supports all corporate and administrative functions of PREPARE.

> "Staying connected regionally and internationally has emerged as one critical lesson from the COVID-19 pandemic. Many of NCID's technical experts have been actively supporting WHO and other international bodies.

Our staff stood together responding to another year of the COVID-19 pandemic. Their commitment to our mission of protecting the people of Singapore from infectious diseases has been outstanding. Their resilience was recognised by the nation last year. Congratulations to the 116 staff and three teams from NCID for being awarded the National Awards (COVID-19).

Staying connected regionally and internationally has emerged as one critical lesson from the COVID-19 pandemic. Many of NCID's technical experts have been actively supporting WHO and other international bodies. In 2022, we hosted 36 visits and meetings with 24 local, regional and global counterparts, discussing areas ranging from future bilateral meetings or joint symposiums to bilateral training and education, and joint research opportunities. With good international connections, we can get first-hand information on any new diseases. The visit to the centres of excellence for research in infectious diseases in Australia – The Peter Doherty Institute, The Kirby Institute, Australian Centre for Disease Preparedness and Sydney Institute of Infectious Diseases – in 2022 has strengthened the existing partnerships with NCID. To establish stronger ties, NCID is currently working with these institutes to get the MoU signed.

Emerging infectious diseases will be a recurrent challenge. To this end, NCID is ever ready to respond to future outbreaks and/or other novel pathogens that may emerge.

SPECIAL MESSAGE FROM

PROFESSOR KENNETH MAK

DIRECTOR-GENERAL OF HEALTH,
MINISTRY OF HEALTH, SINGAPORE

As I pen this message to the National Centre for Infectious Diseases (NCID) for the Centre's 2022 corporate yearbook, I cannot help but reflect upon the importance of NCID's role in helping Singapore navigate what has been described as the crisis of our generation – the COVID-19 pandemic.

Barely four months after it officially opened in September 2019, NCID was swiftly called to action when the first COVID-19 case arrived on Singapore's shores on 23 January 2020. Since then, NCID has demonstrated that it was an invaluable partner, supporting the Ministry of Health (MOH) in its campaign to manage and control the COVID-19 pandemic in Singapore. NCID demonstrated strong and deep commitment over the past three years in providing the full spectrum of clinical, operational public health, and research support to anchor the initial response to the COVID-19 crisis, and subsequently navigate the path towards endemicity. By establishing best practices in infection control, communicable disease management and by producing national treatment guidelines for the treatment of COVID-19 infection, NCID led the Infectious Disease Physician community and our healthcare institutions in treating patients with COVID-19 infection. Through research conducted by NCID, we deepened our understanding of how COVID-19 infection spread in the community and guided our public health responses nationally.

In addition to COVID-19, NCID had to deal with other infectious disease threats that knocked on Singapore's doors. In late June to early July 2022, we reported our first imported and locally transmitted mpox cases. This was amidst a wave of mpox cases reported around the world, beyond that normally in Africa, where the infection was considered endemic. Despite having devoted much of its resources towards dealing with COVID-19, NCID worked with MOH to come up with drawer plans for the surveillance, triaging and management of suspected and confirmed mpox cases. We were thus able to deal confidently and without hesitation when we detected our first mpox imported case and local case. NCID's swift and decisive actions in planning, executing and swiftly adapting its response to infectious diseases threats was a clear demonstration of how NCID was able to fulfil its national mandate to safeguard the health of Singaporeans.

Even after our return to DORSCON Green, we cannot be complacent. While we remain vigilant to a resurgence of COVID-19 infections in our community, this is now the time for us to review the lessons of managing the COVID-19 pandemic and to shore up our defences in anticipation of future infectious disease outbreaks, whether from known or as yet unknown pathogens. The COVID-19 pandemic highlighted the importance of scientific evidence and data in informing policy and public health responses. It catalysed international collaboration and knowledge sharing, as countries worked together to find solutions to detect, treat and prevent the disease.

In November 2022, MOH launched the Programme for Research in Epidemic Preparedness and REsponse, or PREPARE, a dedicated research programme designed to strengthen pandemic preparedness and response capabilities. As the administrative host for PREPARE, NCID will play a crucial role in bringing together researchers from different institutions and disciplines together to develop expertise to further strengthen early detection, diagnostics, therapeutics, and vaccine development in Singapore.

To describe the past few years as challenging would be an enormous understatement. The turbulent times however, have clearly revealed the mettle of NCID's leadership and staff, and demonstrated just how adaptable and nimble the Centre has been in times of crises. I am immensely grateful to everyone at NCID for your extraordinary contributions and wish the team continued success in protecting the people of Singapore from infectious diseases.

SPECIAL MESSAGE FROM

PROFESSOR PHILIP CHOO

GROUP CHIEF EXECUTIVE OFFICER,
NATIONAL HEALTHCARE GROUP

2022 marked the third year of the COVID-19 pandemic globally. During the year, Singapore saw several sub-variants of the highly transmissible but less lethal Omicron strain in March, July, October and November. This resulted in a resurgence of cases and sparked the need for more community-based facilities to take care of stable patients with mild COVID-19 symptoms but who required closer monitoring. To augment the nation's hospital capacity, Tan Tock Seng Hospital (TTSH) opened a 55-bed COVID-19 Treatment Facility at Ren Ci Community Hospital to care for elderly patients discharged from the National Centre for Infectious Diseases (NCID). This complemented the 250-bed Community Care Facility set up by the Ministry of Health (MOH) and Woodlands Health in Tampines. I am grateful to the National Healthcare Group (NHG) Family who readily stepped up to resource these facilities. Our collective effort ensured better overall management of patient load and specialised care for more critical cases.

NCID's commitment to care for patients extends to those with long COVID. Its long COVID clinic has been seeing patients since November 2021. Majority of the patients appreciated the person-centred, holistic and symptom-focused treatment provided, encompassing education and emotional support, as well as timely referral to relevant specialists at TTSH, such as rehabilitation medicine.

Though NCID was at the forefront of the COVID-19 battle, it did not detract from its mission to keep the population safe from other infectious diseases. The discovery of a cluster of tuberculosis (TB) cases in Jalan Bukit Merah was a stark reminder that we must stay vigilant to tackle the re-emergence of diseases. The TB screening organised from May to August 2022 for residents, workers, and former residents and tenants of the affected HDB Block 2, whether on-site or off-site, ensured early detection and treatment of identified cases. Besides TB, the other public health concerns which NCID helped manage were dengue, as well as mpox, which had reported cases last year.

To fortify our nation's preparedness for potential outbreaks, NCID contributes by strengthening disease prevention through surveillance and providing timely clinical and public health response. Such work entails collaboration with the wider community for more effective prevention and management. Last year, the National Tuberculosis Programme team partnered Sembawang West Constituency Office, and AWWA on TB awareness talks for their residents and clients. Emphasised were the importance of early screening, and ways to safeguard personal health and the health of those around them. This is aligned with NHG and our Institutions' strategy to build communities of care through public education and engagement, which resonates with *Healthier SG*'s call for more activated individuals and preventive care for better population health outcomes. Another example is the introduction of HIV Self-

Testing Pilot Programme by the National HIV Programme. HIV self-testing can now be done in the privacy of one's home and involves self-collection of oral specimen using a swab. HIV self-testing complements existing HIV testing modalities available at polyclinics, private clinics, hospitals, and anonymous HIV test sites. Regular testing and early diagnosis allows persons living with HIV to receive prompt treatment for better health.

Recognising that digital transformation is key to ensure that our health systems are robust, efficient, and sustainable, the Next Generation Electronic Medical Record (NGEMR) System went live at NCID, together with TTSH, National Neuroscience Institute, Ang Mo Kio-Thye Hua Kwan Hospital, and Ren Ci Community Hospital in July last year. The roll out of NGEMR has created more seamless access to clinical information by this community of carers, and enhanced delivery of care and patient experience.

I would like to express my deepest appreciation to NCID for your dedication and hard work, and to acknowledge your various accomplishments. Some 116 NCID staff and three teams were honoured with the National Awards (COVID-19). My heartiest congratulations to the recipients for having made outstanding contributions to the nation's fight against the pandemic. I would also like to congratulate Associate Professor Lim Poh Lian, Director, High Level Isolation Unit and Head, Travellers' Health and Vaccination Clinic, TTSH, who was presented the National Outstanding Clinician Award at the National Medical Excellence Awards 2022, in recognition of her leadership and stewardship in advancing infectious disease outbreak response and preparedness in Singapore and internationally.

Today, our population is largely vaccinated and the bivalent vaccine introduced in October 2022 has kept us well-protected from severe COVID-19. On 13 February 2023, Singapore took further steps to treat COVID-19 as an endemic disease, thus enabling us to regain normalcy in much of our everyday life. We moved from DORSCON Yellow to Green, stood down the health Protocols 1-2-3, and lifted mask-wearing on public transport, and indoor healthcare and residential care settings. To reach this milestone, it took the fortitude, devotion and courage of many who worked tirelessly on the frontlines and behind the scenes, including those in public healthcare. I am immensely proud of the collective leadership and selfless spirit displayed by our staff, working together within, across and beyond NHG to care for the population. The White Paper on Singapore's Response to COVID-19 released on 8 March 2023 aptly described our frontliners as the "bright spark". The White Paper also provided good insights on areas we can do better to prepare for future crises. A key plan announced by MOH in response to the lessons drawn is the setting up of a new Communicable Diseases Agency to oversee disease preparedness, prevention and control, surveillance, risk assessment and outbreak response. It will give us added flexibility and dexterity in handling future pandemics. The new agency will consolidate the relevant public health functions that today reside in MOH, NCID and Health Promotion Board. In the coming months, NHG, TTSH and NCID will work closely with MOH to ensure a smooth transition for all relevant services, and for our staff and patients.

Change is inevitable as we shift to a higher gear to provide better health for our population. In the face of an evolving landscape, let us remain focused, vigilant, and adaptable, and stay united and grounded in our core values to serve our nation.

HEALTH EMERGENCY PREPAREDNESS AND RESPONSE

FOR A HEALTHIER SG

PREPARING FOR THE NEXT PANDEMIC

Drawing from past lessons and understanding the importance of a coherent outbreak response

At the end of 2021, there was no bright light at the end of the tunnel to signal triumph over the COVID-19 pandemic. As new variants of concern (VOCs) continued to emerge globally in quick succession, from Alpha to Beta and then Delta in 2021, what would be the next VOC for 2022? Then, the World Health Organization (WHO) declared the arrival of the Omicron VOC at the end of November 2021. Would this be the final one?

LOOKING BACK AT 2022

The Delta VOC was first detected in Singapore around late April 2021 and the number of reported cases eventually declined to basal level after eight months. Singapore remained on constant alert to sniff out new emerging strains.

We started 2022 with an unprecedented large Omicron wave descending on our shores. The number of COVID-19 cases peaked at 26,032 on 22 February 2022 and the wave lasted around four months. During the first eight weeks of this steep rise in COVID-19 cases, we held our breath and scrambled to understand the science of the new Omicron VOC. How virulent is this Omicron VOC compared to the earlier VOCs? At the National Centre for Infectious Diseases (NCID), we reviewed the clinical outcomes of patients admitted with Omicron. Correspondingly, we adjusted the admission, decanting and discharge criteria to allow more people who are at a lower risk of severe illness and complications to recover at home or in the community.

With the proactive case management, our healthcare institutions withstood the "Omicron" test and adequately met the demand of hospitalisations and care was never compromised. We encountered two more Omicron waves, and thankfully fewer people became infected than the first wave.

During the third year of the pandemic, we learned to be increasingly resilient and the public's desire to return to a new normal grew stronger. At the same time, we recognised that the usual pre-COVID-19 load of patients still exists and cannot be neglected. Hence, it became a scaling up of business-as-usual work in tandem with the COVID-19 surge capacity that we have built up over these three years.

Primary prevention against COVID-19 infection through good personal hygiene and vaccination were continually emphasised to the public. Over 92 per cent of our resident population has received the primary course of COVID-19 vaccination. Many have heeded the call to receive their first

Adj Asst Prof Shawn Vasoo,
Clinical Director

and second boosters when these were made available in phases. However, despite receiving the COVID-19 booster, Singaporeans were still getting infected with the Omicron VOC. As NCID gathered more data from our patients infected with Omicron, we were assured that vaccination reduced the severity of infections across all ages.

As we progressed in 2022, the Omicron VOC continued to evolve with multiple sublineages. Among the largely vaccinated Singapore population, infected individuals generally had mild infections, among them 15-18 per cent were infected more than once.

We have now arrived at a significant milestone after an arduous three-year through the COVID-19 pandemic, reverting back to the Disease Outbreak Response System Condition (DORSCON) Green on 13 February 2023. While this transition back to normalcy is welcomed, the impact of COVID-19 will linger on. It is remarkable that Singapore has kept its mortality rates very low for COVID-19 comparatively, but for families both here and elsewhere who have lost their loved ones or whose lives and livelihoods have been directly or indirectly impacted by the virus, life will never be the same again.

INTEGRATION IS KEY FOR A COHERENT OUTBREAK RESPONSE

The country has released a white paper on Singapore's response to COVID-19 on 8 March 2023. It is timely that we take stock of what was done well, and areas where we fell short and need to work on for the next pandemic. Quintessentially, COVID-19 *was* Disease X, which tested our mettle in healthcare and beyond.

A key to a coherent outbreak response is integration, which has to occur at multiple levels:

- In the community to primary care, tertiary care (emergency, inpatient including critical care) and step down care;
- Within the community in various settings – residences, schools, workplaces, dormitories, nursing homes, places of worship and other congregate settings;
- Within the various stages of the disease process, from those who are susceptible, exposed, infected, and recovering, and minimising the risk of infection (via public health measures such as masking and vaccination) or else hastening recovery (via therapeutics);
- In the diagnostic process, from supply chains for testing, pre-analytic steps such as deciding on optimal sampling sites, timing and frequency of testing and who to test, optimising the testing process, and also proper interpretation of tests and results;
- In therapies, from drug and vaccine development, pre-clinical and clinical trials, evaluation and approvals, coherent guidance, procurement and roll-outs for use;
- In data mining, sharing, analysis, and management to inform clinical management and policy
- In research, straddling across the multiple domains listed above, and creating and sustaining ecosystems that nurture research and development
- In a whole-of-government approach, to a whole-of-public and private sector, to a whole-of- country approach, and hopefully a more coherent regional and global approach to epidemics and pandemics.

THE WAY FORWARD

In these three years of the COVID-19 pandemic, we learned to be adaptable and nimble, keeping pace with the discovery of new science as the viral agent continues to evolve. In order to do this, we have to collaborate with multiple internal and external stakeholders, from clinical and epidemiological teams to colleagues handling diagnostics. Multidisciplinary discussions were catalysts to new ideas and approaches to institutional and community care. We have to continue surveillance, be alert and battle-ready. On National Public Health and Epidemiology Unit's end, we continue to conduct surveillance of our COVID-19 patients admitted to NCID and monitor for new VOC that may be more virulent than earlier strains.

Memories fade, battles change, as with pathogens themselves – and also eventually the generation(s) that have to deal with the new Disease X. At the risk of sounding cliché, the adage 'It's not *if* but *when*' rings true. It then is incumbent that gleanings from what we have learnt with COVID-19 are put down in writing, and that these will form part of onward efforts that will result in further investments in people and systems that will enable us to be as prepared as we can be for the next Disease X.

"We have now arrived at a significant milestone after an arduous three-year through the COVID-19 pandemic, reverting back to the Disease Outbreak Response System Condition (DORSCON) Green on 13 February 2023. While this transition back to normalcy is welcomed, the impact of COVID-19 will linger on.

Adj Assoc Prof Matthias Paul Toh, Director, National Public Health and Epidemiology Unit

ADVANCING URBAN HEALTH

EMERGENCIES PREVENTION AND CONTROL

Dr Marc Ho,
Director, Contact Tracing and Epidemiology Centre, Ministry of Health, Singapore

CHALLENGES IN URBAN EPIDEMIOLOGY

The COVID-19 experience has shown that cities and other urban areas can be very vulnerable to pandemics due to high population density, commerce, and connectivity. More than half of the world's population live in urban settings and by 2050, the proportion of population is expected to increase to two thirds. As cities become more complex, local communities are often not adequately consulted in health emergencies preparedness planning and policy formulation. Vulnerable groups also need to be better engaged, informed and involved. Key areas to strengthen include preparedness, prevention and control, surveillance, risk assessment, and outbreak rapid response.

PREPAREDNESS, PREVENTION AND CONTROL

Building on the momentum of the COVID-19 experience, preparedness needs to be a strategic priority in capacity building for disease prevention and control. One key area is to establish a robust and integrated health emergencies system that can quickly and efficiently respond to any public health event. This system must involve the whole-of-society, including stakeholders such as healthcare providers, national security organisations, and local community leaders. Another area is to increase the effectiveness of public communications amidst misinformation leading to confusion and distrust. This can take the form of good campaigns that emphasise proper personal hygiene, respiratory etiquette, vaccination and social distancing in preventing contagious spread.

We have drawn lessons from Singapore's varied experiences in responding to health emergencies as a highly urbanised city-state, from national whole-of-government approaches to specific measures at hospitals and primary care institutions, to targeted protection of vulnerable groups. At their core, public health events are precipitated by ecosystem limitations, economic drivers, and lifestyle choices. Effective governance engaging at

every level with trade-offs that are acceptable is of critical importance.

Strengthening Singapore's preparedness for health emergencies is crucial for maintaining business continuity whilst at the same time protecting the safety and health of residents. Multi-faceted prevention and control should introduce applied epidemiology perspectives with the One Health approach, technology and innovation, and collaboration with stakeholders. This training and education also helps equip individuals and households with the necessary skills and knowledge to respond to an emergency situation.

SURVEILLANCE, RISK ASSESSMENT

Surveillance of emerging infectious diseases involves systematic collection, analysis, and interpretation of information about suspicious events and the knowledge gathered is used to identify outbreaks early, monitor the effectiveness of interventions, and guide public health policies. Risk assessment is a related activity that involves identifying and evaluating the likelihood of a disease outbreak occurring, and determining the potential impact it may have on public health. Together, surveillance and risk assessment help to identify the modes of transmission, the vulnerability of the population, and the availability of resources that can be used to prevent or control the spread of the disease.

We are leveraging data analytics to evaluate public health events, social networks, facilities, transport, housing and zoning, and artificial intelligence to respond to emergency situations. Collaboration between different sectors and stakeholders is also crucial for improving urban health emergency preparedness. The private sector can play a significant role in supporting emergency efforts through the provision of domain knowledge in their industry and volunteers as public health ambassadors. The government can also incentivise private companies to invest in improving public health surveillance.

By filling in knowledge gaps, surveillance and risk assessment efforts provide public health authorities with the essential information to make hard decisions on interventions to prevent and control disease. Data sciences and genomics are greatly assisting our traditional fieldwork at the human-animal-environment interface. Through the use of these tools, public health officials can identify and respond to emergent threats, and mitigate the impact of health emergencies. Hence, we can institutionalise outbreak alert and response, monitor affected populations closely, and maintain vigilance on the infectious diseases burden on society.

OUTBREAK RAPID RESPONSE

Outbreak rapid response, to be effective, involves coordinating a myriad of moving parts such as epidemiological investigation, contact tracing, clinical management, healthcare epidemiology, infection prevention and control, laboratory testing, trend analysis and outbreak management. Timely and accurate actions are required to identify the disease, limit its spread, and ensure that individuals who are infected receive the proper treatment. In addition, health authorities must always communicate with the public to provide updated information on developments of public health importance.

Strength then lies in knowing how to effectively advance a multisectoral approach in handling these public health events. Singapore has acquired social and environmental insights drawn from decades of nation building in Singapore's transition from third world to first world. Ethnic groups comprise the Chinese, Malays, Indians, Peranakans, Eurasians, Europeans, and others, making it cosmopolitan and among the most religiously and culturally diverse in the world. As a cosmopolitan Southeast Asian city-state, Singapore shares regional concerns with Association of Southeast Asian Nations and other countries. Strength also lies in knowing how to engage internationally on technical concerns across regional countries.

On 27 May 2022, the 75th World Health Assembly of World Health Organization adopted a resolution on *Strengthening Health Emergency Preparedness and Response in Cities and Urban Settings*. This widely supported resolution urges states to invest sufficiently in urban health emergency preparedness and adopt a whole-of-government and multisectoral approach in planning and response to health emergencies in cities, with emphasis on including subnational levels and subpopulations. Its adoption signals clear recognition of the critical role in health emergencies played by cities, being vulnerable to outbreaks but also having the capacity to deliver a strong response.

> "We are leveraging data analytics to evaluate public health events, social networks, facilities, transport, housing and zoning, and artificial intelligence to respond to emergency situations.

Assoc Prof Steven Ooi, Senior Consultant and Singapore Field Epidemiology Training Programme Director, International TEPHINET Advisory Board Member

EYES ON DISEASE X

Prof Wang Linfa, Executive Director, Programme for Research in Epidemic Preparedness and REsponse (PREPARE) and National Centre for Infectious Diseases (NCID) Visiting Advisor shares his expertise on emerging infectious diseases and what we can do to prepare for Disease X.

Prof Wang Linfa, Executive Director, Programme for Research in Epidemic Preparedness and REsponse and NCID Visiting Advisor

How are zoonotic diseases related to emerging infectious disease pandemics?

The definition of zoonotic disease means that the disease spreads from animals to humans.

To define an emerging disease, there are three possibilities: the first is that it is previously not known, the second is that it is previously known but becomes more pathogenic, and the last is that the geographical location changed. The majority of emerging infectious diseases that could affect humans nowadays are zoonotic. Human infectious diseases like measles and mumps are under control today because we understand them well and have the vaccines. However, zoonosis is new to the human population, which means that we don't have existing immunity for it.

Pandemics occur when you have a disease that spreads to different continents and impacts the whole world. So this is how they are related.

According to the World Health Organization (WHO), Disease X is an unknown pathogen that could cause a serious international epidemic. What, in your opinion, would be the cause?

While we cannot predict what Disease X will be, we know what the risk groups of pathogens are. To define Disease X as a pandemic, it most likely will be a respiratory virus, and less likely to be a bacterium or parasite. The top three candidates are 1) influenza, 2) coronavirus, and 3) paramyxovirus. Number two and three are always debatable, but influenza is always number one. Even after COVID-19, we (scientific community and healthcare professionals) still think that flu is more transmissible and there are many more varieties that may emerge.

Humans used to suffer heavily from paramyxovirus. We had measles, mumps, parainfluenza, respiratory syncytial virus, Nipah virus and Hendra virus. These are all subgroups of paramyxovirus. Virus classification goes according to the family, the genus and then the species, so when I talk about the family level, the main three types are influenza, coronavirus, and paramyxovirus. So while we cannot predict Disease X, we can predict that these virus types would most likely be responsible for Disease X.

Would Disease X be a situation similar to what we experienced with COVID-19?

Yes and no. Yes, it will be a pandemic and spread via human-to-human transmission. No, the virus could be more lethal but less transmissible, just like SARS-1. The impact will be different; (if it is more lethal but less transmissible) I think the societal impact will be smaller, but the individual impact will be greater. For SARS-1, there was a 10 per cent case fatality rate, MERS 30 per cent, Nipah 50 per cent. But for COVID-19, there were fewer people dying. The official case fatality is really below one per cent, and the early stages in Wuhan was around two per cent. But that was only because we didn't know much about the virus then.

I think Disease X would be similar to COVID-19 because all respiratory virus pandemics impact the whole society; but whether or not the fatality rate would be similar to COVID-19? We don't know.

How do emerging infectious diseases affect our population?

There are two types of impacts – direct and indirect. The direct impact is on an individual level, where people get sick and quarantine; and some cases may unfortunately be more severely ill. Indirectly, it is the social impact, which is more severe and difficult to quantify. I still remember up until COVID-19, the scientific community always put a dollar value on an outbreak. But for COVID-19, I don't think anyone wants to try. I would say there is a much deeper indirect impact that resulted from the pandemic – the geopolitics of the world changed, and this is going to have a very long-term impact.

How can we as individuals be prepared and ready to respond to future health emergencies?

I have always said that when you get vaccinated, you're doing it 30 per cent for yourself, 70 per cent for the nation. This message is very clear in my mind, but how do we get this message out? This is where the government and other organisations need to come in to spread the message on the importance of vaccination, especially in schools for children who are very young. The government, research organisations, and schools all have a responsibility to educate the population that during a pandemic, keeping yourself safe is not enough.

As individuals, we will need to promote the message that all of us have a role to play during a pandemic. The first way is to set an example by wearing masks if required and following safe management measures. The second is to influence your peer group and your family members. The last, and most challenging, is to share the Singapore experience during COVID-19, such as circuit breaker and the like, with friends overseas. It is not enough for us to just play our roles within Singapore. We can influence our neighbours and our social groups to work hand-in-hand with the government, scientists and clinicians to prevent a future pandemic.

Based on your experience with COVID-19, what were some things that Singapore did well?

What we did really well was how we promptly set up the National COVID-19 Research Workgroup (RWG), which played an important role in helping us understand COVID-19. Even my colleagues from the United States were so impressed that we had a national coordinated network from day minus one, even before we had a first confirmed case. COVID-19 has made us truly national, where all clinicians and scientists are now working with each other closely. It benefitted so much from our point of view, because if we work well, the society benefits.

Secondly, even as a tiny nation, our research not only guided our own policymakers but provided scientific evidence and reference points for policymakers internationally. It was basically because our science is trustworthy, that other nations want to take reference from. It was very pleasing to see that. For the general public, it may be hard to appreciate that we were leading the world in this way, but for scientists like myself, we're very proud of that.

What are some things we could improve upon to be prepared for Disease X?

In my mind, it is very clear that if we want to do well for Disease X, we need something like PREPARE where during peacetime, you do nothing but prepare for the war. It's similar to the military; military preparedness is for humans fighting humans, whereas pandemic preparedness is for humans fighting pathogens. The latter should be easier to succeed if we work together because we're not fighting each other, we're fighting a common enemy. So what we can do better is to build a team and practice drills during peacetime.

This is what PREPARE is all about. While we do not have a physical PREPARE institute, we want our key scientists from universities, NCID, Agency for Science, Technology and Research (A*STAR) and many others to be able to practise with the national team. Using an analogy for national sports team, each team can play for their own clubs and focus on their own areas of expertise during non-competition time. If the competition starts within a day, I know who plays in which position, and they know it as well.

An aspect that I think Singapore didn't do very well was in research translation. The cPass kit and A*STAR's PCR kit were the only ones to have gone from basic research to product. So we had one PCR kit and one antibody kit, but we didn't have an antigen detection kit, other vaccines or therapeutics. We had good research base and outcomes in these areas but nothing translated into a real product or had an impact. So that's one gap we are trying to fill, and it requires PREPARE to work with the industry experts during peacetime as well.

What role does PREPARE play in Singapore's health emergency preparedness and response? What are some key research breakthroughs that PREPARE is handling that can help us prepare for future health emergencies?

In Singapore's context, saying we need PREPARE may seem conflicting because on one hand Singapore managed COVID-19 really well, but on the other there is a need to stress research in pandemic preparedness. In terms of technological advancements and rule-based behaviours, we are up there; but we are also a small city nation and we are a travel hub, which puts us at a high-risk (of having emerging infectious diseases entering Singapore). If we're going to establish something like PREPARE and make an impact, then Singapore is the best place to do so. That's why the government responded very quickly to establishing PREPARE.

In terms of research breakthroughs, I call it a platform breakthrough. We want to build these platforms as a pathogen agnostic capability that can take a plug and play approach in the management of different diseases, whether it's influenza or coronavirus. Equally important is the society, education, awareness, and the role of the citizen. So the research programme will see how we can do better, but we need the public to work together. The PREPARE research team alone will not be able to do all the heavy lifting.

PREPARE is supported by the Singapore Ministry of Health's National Medical Research Council under its National Epidemic Preparedness and Response R&D Funding Initiative (MOH-001073-00)

MULTISECTORAL RISK ANALYSIS AND RESPONSE TO OUTBREAKS

EMERGING OUTBREAKS SITUATION

The emerging infectious diseases (EIDs) of public health importance have caused outbreaks throughout the world, and demonstrated significant threats at the human-animal-ecosystem interface. Most obvious are the zoonotic EID links which comprise:

- Novel contagion with pandemic potential, as in avian influenza, Nipah virus infection, SARS, MERS and COVID-19
- Mosquito-borne diseases, as in Japanese encephalitis (JE) and Zika virus infection
- Mammalian vectors, as in hantavirus infection, leptospirosis and rabies
- Food safety and security issues, as in E Coli O157 and Group B streptococcal infection
- Abuse of antibiotics, especially with livestock and fish farming, in the development of antimicrobial resistance (AMR) and emergence of multidrug-resistant organisms (MDROs)

More than 60 per cent of global EIDs are zoonotic in origin. These events will continue to challenge public health systems in countries for years to come. Global hotspot maps of spatial variation in zoonotic risk index have shown that East and Southeast Asia house locations with high estimated EID risks. It is therefore no accident that our neighbourhood is at the centre of global attention regarding EIDs after the emergence of COVID-19, SARS, Nipah virus, and recurring emergence of new recombinants of influenza virus, the pathogen causing the avian and swine flu.

Ecosystems maintain healthy populations, but when mismanaged or rapidly altered due to human pressure, they are associated with zoonotic spillovers. The public health (and economic) challenges of such spillovers in our region include potential outbreaks of avian influenza, hantavirus, JE, leptospirosis, Nipah virus, rabies and coronavirus infections. They underscore an urgent need at the human-animal-ecosystem interface to improve surveillance, risk assessment and characterisation, and to engage various stakeholders on preventive measures.

MULTISECTORAL RISK ANALYSIS OF EIDS

In general, any situation which leads to increased contact between wildlife and humans, between wildlife and livestock, or between previously separated wildlife species, is a potential zoonotic risk situation. Contributing factors are changing demographics, land use, economics and lifestyle, and global developments such as climate change and microbial adaptation. In the last decades, large-scale changes in human ecology, including human encroachment on wildlife habitat and

Assoc Prof Steven Ooi, Senior Consultant and Singapore Field Epidemiology Training Programme Director, International TEPHINET Advisory Board Member

> To manage bio-surveillance and threat mitigation, Singapore applies a One Health framework protocol to undertake bio-surveillance strategies, pandemic emergency preparedness, urban health security, capacity building for integrated response, health risk assessment and management, and community alert and response.

an increase in wildlife trade, have spurred the increased emergence of such situations.

To manage bio-surveillance and threat mitigation, Singapore applies a One Health framework to undertake bio-surveillance strategies, pandemic emergency preparedness, urban health security, capacity building for integrated response, health risk assessment and management, and community alert and response. Our Singapore experience has identified four areas to strengthen the One Health framework: 1) strengthening institution-level systems; 2) managing risks and vulnerability; 3) integrating community-based responses; and 4) cooperating strategically for disease control. Strategies addressing AMR, for example, cannot be confined to a single sector and requires surveillance and risk assessment, research, prevention and control of infection, optimisation of antimicrobial use, setting up of an AMR coordinating office, and regional and international collaboration.

The key to combating EIDs is a multisectoral response involving activities across several sectors, such as community development, health, education, agriculture, and infrastructure. This is often used in the context of whole-of-society initiatives and involves collaboration among different government departments and other stakeholders from a variety of sectors, such as civil society organisations, the private sector, and community groups. By working together, these parties can create healthier and more sustainable solutions to development challenges. The One Health framework for the control of zoonoses and AMR, bio-surveillance and threat mitigation can address complex, multisectoral and interdisciplinary areas of essential public health work in an emergency.

RESPONSE TO HEALTH EMERGENCIES

Disease surveillance needs to be combined with data from other sectors beyond health to facilitate timely assessments that guide decision-making and response in consideration of some social determinants. Various sources and types of information are needed to assess exposure and contextual vulnerabilities as part of the risk assessment and for decision-makers to formulate the objectives, nature, scale, timing and types of response needed. No single surveillance system or information source is suitable for all purposes, as each one varies in terms of objectives, timeliness, sensitivity, representativeness and completeness. Consistent information about a public health event from multiple sources increases confidence that a signal is credible and requires further investigation.

Our field epidemiology service must comprise officers proficient in handling national surveillance programmes, event-based monitoring, field epidemiologic investigations, and epidemic response capabilities. Early disease detection relies on astute physicians and primary healthcare practitioners, an efficient national disease surveillance system, and close collaboration between the many agencies which have to work together. Communications are disseminated in a timely and accurate manner so that medical practitioners, stakeholders and the public can make informed decisions and participate in prevention and control. Often, public urgency and government reaction dictate the need for immediate control measures while an investigation is ongoing. Public health response measures include, among many actions, establishing a task force/outbreak response team, managing ill persons, sizing the extent and severity of illness, instituting epidemic control measures, and undertaking risk communications.

The management of health emergencies is an exciting and growing field. We have to investigate an identified hazard and support the mitigation of specific associated risks, as well as provide a basis for management and communications decisions. Operational tools are available for this kind of joint assessment to identify the risks posed at the human–animal–environment interface within a population and geographical area. Risk framing is typically completed and shared before the technical team starts its assessment. In risk characterisation, based on likelihood and impact estimates, considering the uncertainty level for each of the risk assessment questions, and given the situation and national context discussed, a qualitative technical interpretation of the overall risk assessment is provided. Outbreaks prevention and control requires national surveillance programmes, event-based and internet-based real-time surveillance, field epidemiologic investigations, epidemic response capabilities, travel health and hospital control measures. Infection prevention and control with standard and transmission-based precautions must be observed when caring for patients who are, or are suspected to be, infected by an EID for which additional requirements are needed to prevent spread.

PATIENT CARE

FOR A HEALTHIER SG

MULTIFACETED EFFORTS IN THE PROVISION OF PATIENT CARE

Adj Asst Prof Shawn Vasoo, Clinical Director

Dr Margaret Soon, Director of Nursing

Rather than a '100-meter sprint', the last three years battling COVID-19 were more of a 'marathon' with 'intermittent spurts' and 'side-events'. We are glad to say that the clinical family groups – medical, nursing, pharmacy, medical social workers – and the staff providing vital support services such as our allied health, laboratory, radiology, facilities and operations colleagues continued to respond ably and nimbly to each challenge thrown to us by both COVID-19 and our business-as-usual (BAU) operations.

The National Centre for Infectious Diseases (NCID) responded to each surge on campus. Nationwide, we continued to receive transfers for COVID-19 cases where additional capacity was needed and complicated cases who needed inpatient and critical care. We also received Singaporean COVID-19 patients who needed to be evacuated home for further management.

In the midst of our response to COVID-19 in 2022, an mpox epidemic arose. NCID worked closely with the Ministry of Health (MOH) to formulate national guidance on quarantine and home recovery, and vaccination (ACAM2000 and the newer Jynneos vaccine) protocols. Mpox and other global events (e.g. climate change and conflict) reminded us that as a system that responds to crises, including infectious disease outbreaks, crises are multi-dimensional and require an integrated response.

NATIONAL LEVEL CONTRIBUTIONS

Beyond our campus, NCID continued to lead efforts keeping our national COVID-19 guidance on therapeutic management up-to-date through the COVID-19 Therapeutic Workgroup, with the eleventh update issued in December 2022. Furthermore, working with the MOH and the National Infection Control and Prevention Committee, personal protective equipment use for COVID-19 was further rationalised nationally by MOH in September 2022 with increased information on the characteristics of the Omicron variant and the main modes of transmission of COVID-19. In addition, the 'CAVES' criterion (Comorbidities of concern, Age, Vaccination status, Examination/ Clinical findings and Symptoms), which was developed by NCID based on our experience with our initial waves of patients to evaluate who was safe for home recovery, continued to

be refined and implemented nationally together with MOH Crisis Strategy and Operations Group. It is heartening to see how much we have progressed in the fight against COVID-19, in an evidenced-informed way.

Various members of NCID also continued to serve in committees and groups vital to our COVID-19 fight and epidemic/pandemic preparedness. These included the Vaccine and Therapeutic Workgroup, Therapeutics and Vaccines expert panel, the Expert Committee for COVID-19 Vaccination, the Vaccine Injury and Financial Assistance Programme and Severe Illness and Death from Possibly Infectious Causes Programme, Programme for Research in Epidemic Preparedness and REsponse (PREPARE), and the National COVID-19 Research Workgroup, which has now evolved to the PREPARE Research Workgroup.

CONTRIBUTIONS TO THE COMMUNITY

NCID also continued our community infection control efforts and partnership led by Clinical Lead of Healthcare-Associated Infections Dr Kalisvar Marimuthu and Director of Nursing Dr Margaret Soon, with various sectors including the COVID-treatment facilities, MOH Primary Care and Community Division, the Agency for Integrated Care, the Ministry of Social and Family Development (MSF) and the Ministry of Manpower.

The NCID Infection Prevention and Control team and nursing team collaborated with MSF to design and conduct the Basic Infection Control Training Programme for those working in MSF homes. The two-day programme used a creative mix of lectures, team based learning, and gamifications in the content delivery, providing the faculties with the opportunities to explore the different teaching pedagogies.

IMPROVING PATIENT CARE

At the hospital level, to improve the quality of patient care and professional practice in the NCID nursing team, the team welcomed Advanced Practice Nurse (APN) Cheng Hong who had transferred her practice to NCID as an infectious diseases APN. The value of APNs in the hospital settings have been extensively reported and are associated with shorter length of stays for patients, more collaboration and better coordination between professional groups, reduced mortality and greater patient satisfaction.

On NCID Pharmacy's end, Senior Pharmacist (Clinical) Lim Jia Hui and Senior Pharmacist Annabel Chua completed the National Collaborative Prescribing Programme and are now a registered collaborative prescriber. Through the programme, trained pharmacists and APNs are able to prescribe medication under a collaborative agreement with the medical collaborators. They can collaborate with the physician on the management of chronic diseases and hence provide optimal care of patients at NCID.

STRENGTHENING RESEARCH

The first study by nurse researchers on "Exploration of Factors Influencing Nurses' Preparedness and Response to the COVID-19 Outbreak" was published in *Sage Open Nursing* in December 2022. Senior Staff Nurse (SSN) Daphne Fernandez Dicson Fernandez, SSN Chua Tiow Shen and SSN Phoon Yan Ling conducted the study to gain insights on the experience of nurses working on the frontline, while they themselves were battling the pandemic on the frontline. Their findings provided insights to the nursing leadership on how to better manage the nursing workforce and be better prepared for future outbreaks and pandemics.

Similarly, NCID Pharmacy also contributed to research bringing new data and information that could impact patient care. Senior Pharmacist (Specialist) Grace Hoo published a total of four clinical papers. Of which, one was on "Therapeutic drug monitoring of meropenem and piperacillin-tazobactam in the Singapore critically ill population — A prospective, multi-center, observational study (BLAST 1)" published in *Journal of Critical Care*. Senior Pharmacist Tay Jun Xin collaborated

> "Mpox and other global events (e.g. climate change and conflict) reminded us that as a system that responds to crises, including infectious disease outbreaks, crises are multi-dimensional and require an integrated response.

Dr Ho Lai Peng,
Senior Principal Medical Social Worker

Ms Law Hwa Lin,
Senior Principal Pharmacist (Specialist)

“Among the many lessons that we had learnt in the past year, we recognise that it is important to remain nimble and adapt according to the demands, remain vigilant and always be ready to respond and remain centred on our mission, to protect the people of Singapore from infectious diseases.

with physicians to publish “Real-World Use of Sotrovimab for Pre-Emptive Treatment in High-Risk Hospitalised COVID-19 patients: An Observational Cross-Sectional Study”.

ROLE OF TECHNOLOGY IN OUR WORK

As we improve health outcomes of our patients, our health systems should also be more efficient, resilient, and sustainable. One way to do so is through the use of technology. NCID Pharmacy saw the full implementation of its smart shelves in 2022. The smart shelf aims to enhance medication safety to patients by employing technology such as the ‘pick to light’ system and weight sensing mechanism. This ensures that medication is picked and packed accurately. This system is also synced with inventory management to ensure the right medication is replenished onto the shelves.

The pandemic has forced us to rethink social work care delivery and provided the catalyst for medical social workers (MSWs) to incorporate digital technology into their work. There are benefits for MSWs to use technology to engage patients as it provides options for those who have mobility issues or have defaulted medical appointments. During the pandemic, phone and video calls provided an efficient means to conduct financial assessments and administer assistance. MSWs were able to maintain contact with patients even during the circuit breaker period and institution of safe management measures. In addition, MSWs were able to provide comfort for distressed relatives who could not see their very ill loved ones in the wards.

However, there are potential pitfalls. For emotionally distressed patients with poor social support and are socially isolated, there may be no replacement for the person-centred and personalised care which social work is known for.

OUR BIGGEST ASSET – OUR PEOPLE

For NCID to continue to be strong, trusted and united in keeping Singapore safe from infectious diseases, we will need to keep three things at our core:

1. Purpose – to have a strong sense of our mission at our core;
2. Passion – which will be the fuel to keep us going on our mission;
3. People – remembering that people are the biggest asset and should remain at the heart of all we do. The patients and the population are the people we care for. Our staff are the people who fulfill our purpose with passion. We have to ensure staff do not burn out, remain energised and engaged, and are developed as these are the people who support our patients and the larger community.

LOOKING AHEAD

It is timely for NCID and the healthcare community to look at what we can learn and improve for future epidemics. Among the many lessons that we had learnt in the past year, we recognise that it is important to remain nimble and adapt according to the demands, remain vigilant and always be ready to respond and remain centred on our mission, to protect the people of Singapore from infectious diseases.

A HOLISTIC APPROACH TO PATIENT CARE

The National Centre for Infectious Diseases' (NCID) multidisciplinary team of doctors, nurses, medical social workers, pharmacists and operations personnel work in close collaboration to achieve optimal healthcare outcomes through the provision of specialised inpatient and outpatient care to patients.

INTRODUCTION

In 2022, NCID continued to respond to the COVID-19 pandemic with the different surges in cases while supporting business-as-usual (BAU) services. In May 2022, NCID was called to respond to the local mpox outbreak that arose from the mpox epidemic as the world saw an increase in the number of cases beyond the endemic countries in Africa. NCID's clinical and operations teams responded by coordinating and managing resources to ensure optimal bed capacity, manpower deployment and smooth ground operations.

OUTPATIENT SERVICES

COVID-19 Management at Clinic J

2022 saw a shift in national policies for COVID-19 management, where patients with mild or no symptoms could recover at home and/or seek medical attention at primary care facilities. These patients, if assessed to require hospital care by their primary care doctor, would be conveyed to NCID for further medical assessment. Clinic J Special Precaution Area (SPA) continued to support the medical evaluation of COVID-19 patients conveyed to NCID and COVID-19 screening for walk-in patients and staff with acute respiratory illness symptoms.

In the area of COVID-19 care, Clinic J collaborated with NCID Pharmacy and began offering Paxlovid as a treatment in February 2022. Other COVID-19 management supported by Clinic J included follow-up of recovered COVID-19 cases post-discharge from NCID inpatient wards and review of patients with long COVID.

A nurse attending to a COVID-19 patient at Clinic J SPA

Following the Ministry of Health's (MOH's) endorsement in January 2022 on the use of the Evusheld (tixagevimab and cilgavimab) vaccine via the Special Access Route, Clinic J extended support for COVID-19 Pre-Exposure Prophylaxis (PrEP) administration to residents in nursing homes from April 2022 onwards. Residents were screened by the medical team in these nursing homes prior to referral to NCID for Evusheld administration. Clinic J also continued its support as a centralised site for COVID-19 PrEP and Post-Exposure Prophylaxis (PEP) for eligible patients identified and screened within the Novena campus. Clinic J successfully administered Evusheld to 21 patients in 2022.

Management of Mpox Cases at Clinic J SPA

As mpox infections grew worldwide, Clinic J began preparations in early May 2022 to serve as the centralised site in Singapore for the medical evaluation and management of suspect cases, and PEP administration for close contacts of confirmed cases.

Clinic J received the first suspect mpox case at the end of May 2022 and had reviewed more than 40 suspect cases by the end of the year. Suspect mpox cases were initially admitted to NCID for isolation and screening for mpox. In line with the subsequent policy change in August 2022, suspect mpox cases seen in Clinic J SPA were assessed for suitability to be discharged home or to Mpox Isolation Facilities (MIF) via dedicated conveyance while pending PCR swab results. Patients who were found to be positive continued isolating at home or at a MIF, and were then scheduled for a de-isolation medical review at Clinic J. By the end of 2022, 15 patients were assessed for de-isolation and discharged by Clinic J.

Additionally, more than 40 close contacts of confirmed mpox patients were identified through contact tracing conducted by MOH Contact Tracing and Epidemiology Centre (CTEC) and were assessed for PEP eligibility and administration of the ACAM2000 vaccine at Clinic J. As some of these close contacts were children, their PEP eligibility assessment and vaccine administration was conducted with the support of medical professionals and paediatrics teams from National University Hospital (NUH) and KK Women's and Children's Hospital (KKH). Following approval from MOH, the switch to the use of Jynneos vaccine as PEP took effect from 3 October 2022.

In collaboration with the MOH CTEC, Clinic J supported the examination and investigation of potential sources of infection identified by MOH to determine the index case and infectious status. Clinic J also conducted training sessions to share experience and expertise with the ACAM2000 vaccine administration with nurses from NUH, Ng Teng Fong General Hospital and KKH.

Jynneos Vaccination as PrEP for Occupational Groups

As part of the national vaccination strategy in containing mpox infections in Singapore, Clinic J was tasked as the national service provider to administer the Jynneos vaccine as PrEP for three eligible occupational groups – staff with 1) direct contact to mpox patients, 2) direct contact to mpox virus/fomites and 3) indirect but close contact to mpox patients.

Multiple engagement sessions were conducted by doctors from the Department of Infectious Diseases, which included a brief introduction to the Jynneos vaccine and its precautions, for eligible staff to help them make informed decisions on the voluntary vaccine uptake.

A nurse preparing the Jynneos vaccine for administration

The vaccination exercise commenced on 3 October 2022 for staff, and was subsequently extended to external occupational groups with roles in Singapore's mpox case management two weeks later. In 2022, more than 80 internal and external staff have completed both doses of the Jynneos vaccine with no adverse side effects reported.

Real-Time Location System Implementation at Clinic J

The Real-Time Location System (RTLS) was implemented at Clinic J on 11 June 2022 and features an enhanced Queue Management System integrated with the RTLS, where patients received a queue number and RTLS tag simultaneously upon registration while visitors were issued with a RTLS tag based on the patient's queue number. This improved efficiency in patient and visitor RTLS tagging and contact tracing. As patients and visitors are required to hold their assigned tags throughout their time in the clinic, RTLS has the ability to facilitate contact tracing by tracking of patient/visitor movement and interaction, allowing for prompt actions to be taken to minimise any disease spread. Other features of the RTLS include hand hygiene compliance for staff and asset tracking, which allows Clinic J to reduce the risk of cross-contamination and allows for real-time location tracking of key equipment.

Outpatient Parenteral Antibiotic Therapy Clinic-Kwong Wai Shiu Hospital Collaboration

To free up acute beds in hospitals, the Outpatient Parenteral Antibiotic Therapy (OPAT) clinic extended its services to the Kwong Wai Shiu Hospital (KWSH) to facilitate the early discharge of KWSH residents who would otherwise have to remain inpatient for long-term antibiotic treatment. This is one example of a collaboration between OPAT clinic and a nursing home in the community. OPAT clinic received a KWSH patient in July 2022, and OPAT nurses and doctors subsequently visited KWSH to administer treatment and review the resident.

INPATIENT MANAGEMENT

Ramping Up of COVID-19 Isolation and General Ward Beds

There were three major waves of COVID-19 cases in 2022 – with the first Omicron BA.2 subvariant in March, BA.4 and BA.5 in July, followed by XBB in October and November – these, coupled with patients who were not eligible for the Home Recovery Programme (HRP) due to complex comorbidities created a high demand for isolation beds and facilities.

In response to the surge in requests for bed capacity, NCID and Tan Tock Seng Hospital (TTSH) ramped up available COVID-19 "fixed" general ward and isolation beds. These beds were made available at NCID, TTSH main building, CDC 2, as well as COVID-19 Treatment Facilities (CTF) sub-acute beds at Ren Ci Community Hospital. Multiple stakeholders across the campus worked together to operationalise NCID's ramp up plans. This included ensuring infrastructure and IT readiness, smooth patient journey and clinical service delivery from admission to discharge and/or decant and efficient turnover of inpatient beds post-patient discharge.

In addition, cohorting principles continued to be adapted and implemented to group suitable COVID-19 patients together to ensure their safety and well-being as well as maximise resources to balance increasing BAU inpatient workloads and high demands for outbreak beds.

NCID maintains readiness to ramp up in preparation for any sudden surge in COVID-19 cases. To support the nation's COVID-19 surge demand for hospital beds, NCID's BAU inpatient capacity retained the flexibility to be converted into COVID-19 beds. Admitted BAU infectious disease patients were, if required, transferred to the care of TTSH's General Medicine medical team with oversight from NCID's team.

Increased Workload and Optimising Decant Operations

With the streamlining of the management of Omicron cases by MOH, NCID ceased the direct decant workflow for NCID patients to Oasia Hotel Novena. CTFs continued to be the main step-down care decant sites for all patients recovering from COVID-19. In late 2021, NCID saw an increase of elderly patients that qualified for decant to CTFs. These elderly patients were often diagnosed with other comorbidities such as end-stage renal failure, thus requiring haemodialysis and nasogastric tube feeding. As a result, new decant workflows were established. MOH reviewed the national COVID-19 medical policies to enable suitable COVID-19 patients requiring haemodialysis to be eligible for HRP. Between January to March 2022, NCID's Operations team increased manpower deployment from one to three staff daily on a rotational basis to support the surge in workload of daily decant operations.

Bright Vision Hospital, with direct decant arrangements with NCID, remained as the default CTF for COVID-19 patients requiring higher level of medical support as more CTFs and

NCID's nursing and operations teams worked closely together to ensure smooth ground operations

Exploration of Factors Influencing Nurses' Preparedness and Response to the COVID-19 Outbreak

As the epicentre of Singapore's outbreak response, NCID augmented nurses from TTSH to cope with the various surges of the COVID-19 outbreak. To identify the factors influencing nurses' preparedness and response to the pandemic, the NCID nursing research team conducted a qualitative study via face-to-face semi-structured interviews. The study found that nurses' outbreak preparedness and response depended not only on their skills and clinical knowledge, but also on the strategies implemented by management. Additionally, the study revealed that greater effort was required to balance the needs between nurses and management to enhance the former's resilience for future outbreaks. To address these findings, engagement sessions have been conducted to enhance communication transparency, and continued training is planned to retain the ICU-related skill sets of the over 100 nurses who were trained during the pandemic to strengthen outbreak preparedness.

Community Isolation Facilities were stood down with the caseload stabilisation. As we transit to the endemic phase, the decant of COVID-19 patients from NCID continues to be the main source of outflow for the whole of 2022.

Integrated COVID-19 Response through NCID Operations Command Centre

The NCID Operations Command Centre (NOCC) centrally manages the inflow and outflow of COVID-19 and mpox patients across inpatient and outpatient settings in NCID. In 2022, NOCC contributed to the management of Omicron and its subvariants by serving as the nerve centre to collate and report operational data, coordinate outbreak patient inflow and outflow, monitor trends and triggers, and project bed requirements to inform distribution of beds and resources. It also established direct arrangements with other public and private hospitals, and CTFs to expedite patient transfers and supported the national efforts in right-siting patients.

Mpox Inpatient Management and Outbreak Response

Having previously managed Singapore's first mpox case in 2019, NCID was able to quickly activate and adapt existing plans as early as May 2022 to manage suspect or confirmed cases in response to the mpox outbreak. MOH and NCID co-developed a joint guidance for mpox for healthcare professionals in June 2022, which was updated again in April 2023. WHO declared mpox a Public Health Emergency of International Concern (PHEIC) from 23 July 2022 to 11 May 2023.

The Department of Infectious Diseases played an active role in providing upfront triage/screening of the suspect cases reported to MOH. Persons who were assessed to be

NOCC team in a discussion on the inflow and outflow of patients in NCID

at risk were then referred to NCID for further assessment. The suspect cases were triaged by the department and were admitted to NCID for isolation to screen for mpox. If confirmed to be positive for mpox, these cases were isolated and treated at NCID until they were non-infectious or suitable to be managed at designated facilities or at home.

NCID, through NOCC, worked closely with various MOH divisions and task groups to quickly put in place standard operating procedures and workflows to operationalise the medical review, admission and discharge/decant of mpox suspect/confirmed cases in NCID.

In line with local and international data which showed that mpox is typically mild and self-limiting, swab-and-isolate protocols were implemented to allow low-risk suspect cases to be isolated at home or designated isolation facilities while waiting for their results, and the HRP was put in place to allow affected individuals to recover at home. This helped to right-site the care for mpox patients and free up the hospital beds for other acute patients.

In 2022, a total of 19 confirmed mpox cases were reported in Singapore. Of the 19, 16 cases were treated in NCID's isolation ward, two were managed as outpatients in Clinic J under the swab-and-isolate protocol.

Ensuring Outbreak Readiness for High Level Isolation Pathogens

Amid the ongoing COVID-19 pandemic, NCID's High Level Isolation Unit (HLIU) has been preparing its response for other emerging infectious diseases such as the Ebola Virus Disease and Lassa Fever by regularly conducting training and exercises. In 2022, two key exercises were completed: the HLIU Emerging Virulent Pathogen Readiness and Simulation Training (EVEREST) Exercise on 27 October 2022 and the HLIU Technical Staff Recall Exercise on 24 November 2022.

HLIU EVEREST involved a simulation of an Ebola suspect case picked up at the TTSH Emergency Department (ED), and tested coordination among different family groups, retrieval processes and within-HLIU workflows. Findings and recommendations from the exercise were revised and incorporated into relevant SOPs to improve the system readiness and processes.

The HLIU Technical Staff Recall Exercise validated the notification process for activating the HLIU core team, as well as doctors and nurses from KKH and NUH through the simulation of suspect Ebola cases involving a mother and child. Of particular note, the exercise validated the use of hybrid communications involving phone calls and TigerConnect.

Simulated patient retrieval from TTSH ED to NCID HLIU during the EVEREST Exercise on 27 October 2022

Operational and Technical Evaluation of Trials for Self-testing ART Kits

In addition to patient care, NCID's clinical and operations teams also conducted studies and trials to better understand how new technologies and devices work as part of MOH's commissioned evaluations for COVID-19 testing. Led by principal investigator Adj Asst Prof Shawn Vasoo, Head, Infectious Disease Research Laboratory (IDRL), evaluation trials were conducted to study the accuracy of various ART brands, to corroborate company-submitted data to Health Sciences Authority.

In addition, NCID collaborated with National University of Singapore (NUS) to recruit 49 patients for the STARLIT Gesundheit-II Aerosol Study. With the aim of studying the aerosol transmission of COVID-19, the participants were requested to perform activities such as talking and singing with and without masks. The study concluded on 31 July 2022 with findings showing that aerosol shedding of COVID-19 was common in respiratory activities.

Healthcare Educational Series by NCID HIV Programme and Inpatient Nursing Team

The NCID HIV Programme and inpatient nursing team launched a five-module Nursing HIV Educational Series to educate nurses both in NCID and other public healthcare institutions on the fundamentals of HIV care and HIV-related skills. Additionally, a series of HIV Healthcare Education Posters were created and placed throughout the

inpatient wards to educate nurses in NCID on the science of undetectable = untransmittable (U=U), HIV and stigma, and HIV PEP.

PHARMACY

The NCID Pharmacy contributes to the enhancement and improvement of the quality of patient care in NCID by ensuring the reliable and continuous supply of medicines and vaccines to support BAU inpatient and outpatient operations.

Community Outreach and Education

NCID Pharmacy was involved in a webinar on 3 March 2022 organised by the Pharmaceutical Society of Singapore. Ms Law Hwa Lin, Senior Principal Pharmacist (Specialist) was invited to provide an update on oral antivirals for COVID-19 management to all registered pharmacists. More than 300 pharmacists attended the seminar where Ms Law gave an overview of pharmacotherapeutic products that were available in Singapore, discussed their criteria of use and other special considerations, and highlighted pertinent drug interactions between these oral antivirals with common medications used in the local population.

Digital Transformation

As part of NCID's ongoing efforts in digital transformation, NCID Pharmacy replaced its conventional medication shelves at the outpatient pharmacy with smart shelves that employ technologies such as innovative "pick to light" function and weight sensing mechanism. These features ensure that a patient's medication is picked and packed accurately, effectively minimising rework and preventing the supply of wrong medication. The system is also synced with inventory management to ensure that the right medication is topped up onto the shelves. These smart shelves were fully implemented in the NCID outpatient pharmacy in the last quarter of 2022.

Pharmacy Collaborative Prescribing Services

With its introduction in 2018, collaborative prescribing aims to facilitate care transformation by providing a more holistic service with improved treatment continuity in team-based care. To be a MOH-accredited collaborative prescriber, a pharmacist has to complete a three-month National Collaborative Prescribing Programme course by NUS and work with their collaborating medical practitioner to develop and craft clinical practice guidelines as well as scope of practice. Ms Law was one of the first infectious disease specialist pharmacists in Singapore to complete the course and be a MOH-accredited collaborative prescriber. As the first collaborative prescriber in NCID, she has been working with the Department of Infectious Diseases to initiate and implement Travellers' Health and Vaccination Clinic (THVC) collaborating prescribing clinic services. As more NCID pharmacists complete the course and achieve MOH accreditation, there are planned expansion of collaborative prescribing services in Clinic J in addition to THVC in 2023.

Pharmacist picking and packing medications

MSW providing counselling to a patient in the ward

CARE AND COUNSELLING

NCID's Care and Counselling department works closely with the multidisciplinary team to assist patients and their families on their journey towards recovery and healing. Its group of medical social workers (MSWs) plays a critical role in providing counselling and psychosocial support to patients and families who are facing emotional, psychological, social, environmental and practical issues arising from their illness or medical condition.

COVID-19 Rehabilitation Rounds

One of the core functions of MSWs is to provide patients and their families with much needed comfort, physical and emotional care. In 2022, majority of the elderly patients warded at NCID faced challenges in managing their activities of daily living such as bathing, toileting, dressing, feeding, transferring and walking. In view of this, NCID's MSWs took part in weekly multidisciplinary rehabilitation rounds alongside doctors, nurses, occupational therapists, physiotherapists and speech therapists for patients diagnosed with COVID-19. The team identified challenges in care and discussed available services and resources in the provision of support to patients and their families in navigating the caregiving journey ahead.

AGAPE Zentangle Workshop

The AGAPE support group was established in 2010 as a peer-support programme to encourage mutual support among male HIV-positive patients through meaningful workshops and structured activities where they can learn new skills and knowledge for personal or self-development, and enhance their coping or quality of life. After a two-year hiatus due to the COVID-19 pandemic, activities for AGAPE resumed on 29 October 2022, with 12 participants and four MSWs gathering for an afternoon of Zentangle where participants created repetitive patterns by drawing with simple dots, lines, curves, orbs, etc. The workshop introduced participants to an alternative form of art to enhance self-relaxation and focus, and increased their self-confidence and overall sense of well-being.

One-to-One Patient Peer Support

Launched on 1 August 2022, the one-to-one patient peer support group aims to enhance the socio-emotional coping of patients living with HIV through mutually supportive and empathic relationships fostered between an individual and a peer support who share common ground. Since its inception, three patient peer leaders have been recruited under the pilot programme and a few patients have indicated their willingness to receive support under the programme. The pilot programme is expected to be completed by July 2023.

Community Engagement

As part of World AIDS Day, 288 participants – including NCID's Senior MSW Daniel Chee – joined the "I have HIV, Will You Employ Me" panel discussion on 25 November 2022. Organised by the NCID HIV Programme, the participants put themselves in the shoes of Jason, a person living with HIV, and went through various workplace scenarios to raise awareness

about the stigma and discrimination that patients living with HIV face in finding employment. The panel discussion also touched on what employers and colleagues could do to build a safer and more inclusive workplace for those living with HIV.

To further raise community awareness about people living with HIV, Senior Principal Medical Social Worker, Dr Ho Lai Peng spoke at the Singapore AIDS Conference 2022 on 10 December 2022 to share about a patient's journey towards treatment access. In line with the theme of "Empowering Communities to End HIV and AIDS", the conference recognised the critical roles played by communities of people living with HIV, key affected populations and community-based organisations in the fight to end HIV.

Summary:

1. **In terms of COVID-19 management, Clinic J continued to support the medical evaluation of COVID-19 patients. To cater to high demand for bed capacity during case surges, available COVID-19 "fixed" General Ward/Isolation beds were ramped up. NOCC contributed to the management of Omicron and its subvariants by serving as the nerve centre, looking at data and trends to project bed requirements and inform distribution of beds and resources.**
2. **In response to the growing number of mpox cases, NCID quickly mobilised management policies of suspect or confirmed cases in outpatient and inpatient areas. NCID served as the centralised site in Singapore for the medical evaluation and management of suspect cases, and PEP administration for close contacts of confirmed cases.**

Contributed by:
Ms Phoon Yan Ling, Senior Staff Nurse, NCID Nursing; Ms Lim Jia Hui, Senior Pharmacist (Clinical), NCID Pharmacy; Ms Samantha Koh, Medical Social Worker, NCID Care and Counselling; Ms Chong Kai Wei, Assistant Manager, Clinical Operations, Executive Director's Office; Ms Pang Jia Xin, Manager, Clinical Operations, Executive Director's Office; Mr Julian Ng, Assistant Director, NCID Operations Command Centre, Executive Director's Office; Ms Zhong Lihua, Senior Nurse Clinician, OPAT Clinic; Ms Soh Yee Man, Assistant Nurse Clinician, OPAT Clinic; Ms Imrana Banu, Nurse Manager, NCID Nursing; Ms Jasmine Teo, Senior Executive, Clinical Operations, Executive Director's Office; Ms Christine Tin, Executive, Clinical Operations, Executive Director's Office; Ms Siti Nasuhah, Senior Executive Assistant, Clinical Operations, Executive Director's Office; Mr Chong Wah Kang, Executive, Clinical Operations, Executive Director's Office; Ms Daphne Fernandez Dicson Fernandez, Senior Staff Nurse, NCID Nursing; Mr Chua Tiow Shen, Senior Staff Nurse, NCID Nursing; Mr P Arun Kumar, Senior Executive, National HIV Programme; Dr Margaret Soon, Director, NCID Nursing; Ms Yu Liang, Assistant Director, NCID Nursing; Ms Cheng Hong, Advanced Practice Nurse, NCID Nursing; and Ms Tan Yun Hann, Senior Staff Nurse, NCID Nursing

PUBLIC HEALTH LABORATORY INVESTIGATIONS

FOR A HEALTHIER SG

THE CHALLENGES OF GOING DORSCON GREEN

> NPHL's role as a subject matter expert on pathogens has contributed to discussions on strategies, policies and specific sampling measures throughout the pandemic.

Even as we step down to the "COVID-19 endemic" phase – going Disease Outbreak Response System Condition (DORSCON) Green – the National Public Health Laboratory (NPHL) is acutely aware of the need to remain alert to new waves of infection due to new variants of SARS-CoV-2. We also aim to provide the assurance that we can detect any new and unpleasant surprises early. This has to be in place even as testing in the community decreases and notifications are stopped. We therefore work with the Ministry of Health (MOH) public health units to ensure an effective epidemiological surveillance is backed by closely-coordinated laboratory support. For example, choosing the clinic sites for sampling, ensuring that appropriate tests are done, and providing help in understanding the changes in genetic variants. One of Singapore's strengths in this pandemic has been the effective linkages among clinical, epidemiological and laboratory activities, and the collation and analysis of data. This led to faster, suitable interventions – initially for containment measures, later for implementing vaccine and safe distance measures. NPHL's role as a subject matter expert on pathogens has contributed to discussions on strategies, policies and specific sampling measures throughout the pandemic. These have had to be adjusted every few months, as the situation and objectives of surveillance and intervention changed. We hope this contributory role of NPHL will be organic to all future outbreak response plans.

The pandemic has accelerated the adoption of new technologies and approaches throughout the healthcare system, not least in clinical laboratories and NPHL. These include introducing newer generation testing instruments and multiplex respiratory panels. The overall national capabilities and skills in molecular diagnosis of infectious agents has taken a leap forward, and NPHL can now rely on a larger and more well-resourced network of public and private clinical laboratories with whom we work to fulfill our public health mission. We hope that with step-down to endemic COVID-19, the better resources and skills will be permanently embedded in these laboratories.

Even as COVID-19 was occupying all our attention since 2020, other communicable diseases continued to require NPHL investigation. We are also seeing a return of more foodborne clusters, and discovering respiratory clusters and increases due to agents like human metapneumovirus in subpopulations in which we had not observed them before. This could be due to greater social interaction and mixing, at work and with leisure activities.

NPHL has also helped investigate clusters and possible sources of nosocomial infections, linked to human transmission, devices or the environment. Antimicrobial resistance (AMR) continues to be a priority in healthcare, and we will continue to use our developing whole genome sequencing capabilities to investigate new forms of AMR as they arise and how they spread. We have for more than 10 years addressed various emerging issues like CRE, VRE, C. difficile and C. auris. With better technology and expertise, we will continue to support the National Antimicrobial Resistance Expert Panel and National Antimicrobial Resistance Control Committee, key committees formed by MOH.

The national tuberculosis and human immunodeficiency virus programmes have continued to function throughout the pandemic, and so has NPHL's laboratory investigations. This will enable more defined and effective detection of clusters and transmission links, and predict AMR based on genomic information. Some of this work continues to progress with enhancements from year to year.

In the coming years, we will look forward as well to trials and validation of new metagenomics strategies which will enable us to confront a new pandemic with confidence.

Adj Prof Raymond Lin,
Director, National Public Health Laboratory

NATIONAL PUBLIC HEALTH LABORATORY

The National Public Health Laboratory (NPHL) conducts laboratory investigations to support surveillance of communicable diseases, control of outbreaks, and preparedness for new and dangerous pathogens.

INTRODUCTION

NPHL uses the best possible science for the laboratory surveillance of infectious diseases and the investigation of outbreaks. NPHL continued to provide advice and laboratory expertise to support COVID-19 detection, containment, and mitigation efforts in Singapore. It worked with the Ministry of Health (MOH) Communicable Diseases Division in the surveillance and outbreak investigation of foodborne, vector-borne, respiratory, and vaccine-preventable infections, as well as other communicable diseases of public health importance.

COVID-19 INVESTIGATION AND SURVEILLANCE

NPHL monitored the prevalence of different COVID-19 variants in the community. The detection of these potential variants of concern helped MOH to introduce mitigation measures swiftly to reduce the spread of the transmission.

Emergence of BA.4 and BA.5 Cases in the Community

NPHL monitored the circulating variants using S-gene Target Failure (SGTF) and targeted whole genome sequencing (WGS). In April 2022, NPHL detected BA.4 and BA.5 variants at an early stage of their introduction to the community. Increased sampling, fast turnaround and bioinformatic analysis provided MOH real-time information to assess the new COVID-19 variants. It helped in the modelling of the subsequent epidemic trajectory, and monitored the severity associated with new variants via targeted sampling among severe cases and vulnerable groups.

NPHL uses WGS to monitor the circulating COVID-19 variants in the community

Detection of XBB

In September and October 2022, NPHL was among the first in the world to detect and document a new COVID-19 wave from the XBB recombinant virus after adopting a selective and focused sampling strategy. Subsequently, more recombinant variants such as XD, XE, XF, and other BA.2.3 xx sub-lineages were identified and analysed by NPHL. This detection of new emerging recombinants and variants provided a timely alert to the MOH Contact Tracing and Epidemiology Centre and the Ministry of Manpower Assurance, Care & Engagement Group (MOM ACE).

Serological Surveillance of COVID-19 in the General Population Using Residual Blood Samples (2021-2022)

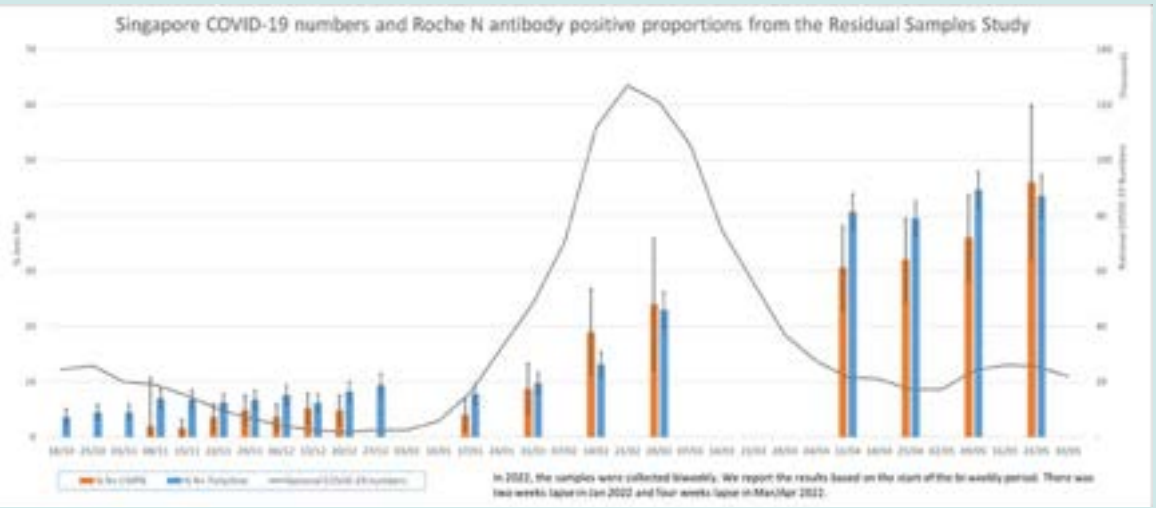
From October 2021 to June 2022, NPHL and the Infectious Disease Research and Training Office (IDRTO) designed and conducted a study to measure serological attack rates of COVID-19 transmission among adults in the general population, track the progress of the COVID-19 pandemic and assess the impact of vaccine roll out in the general population.

This was a cross-sectional, multi-institution, seroepidemiology study. IDRTO coordinated the collection of residual blood samples from health screenings and partner sites, some of which were then processed by the Infectious Disease Research Laboratory (IDRL). NPHL performed antibody tests using Roche N and Roche S assays against the SARS-CoV-2 virus. Thereafter, samples were de-identified for laboratory analyses, and results were cross-checked with the National Immunisation Registry for the patients' vaccination status and the COVID-19 case registry.

From the total of 19,119 samples collected, there was a sharp increase in COVID-19 seroprevalence (shown as Roche N positive) observed in samples collected around mid-February 2022, with a subsequent plateau from April 2022 onwards. In collaboration with MOH Future Systems Office, the serology data linked an individual's COVID-19 vaccination history with whether they were diagnosed as a COVID-19 case. The study found that compared to unvaccinated and partially vaccinated individuals, vaccinated individuals were less likely to be infected. However, infections in vaccinated individuals were more likely to be diagnosed. Compared to non-residents, Singapore Citizens and Permanent Residents were more likely to be diagnosed. In comparison to the rest of the cohort, individuals with higher socio-economic status were more likely to be diagnosed whereas those working in high risk professional groups were less likely to be diagnosed.

The results from this study were presented to study partners and MOH. The findings helped provide insights on the extent of undiagnosed infections in the general population among different age groups, and guide policy decisions on the need for measures to reduce transmission and mitigate disease severity in different age groups.

Staff across various units in NCID – NPHL, IDRTO, IDRL and Public Health Operations – were involved in this study.



Singapore COVID-19 numbers and Roche N antibody positive proportions

OUTBREAK INVESTIGATIONS AND NATIONAL SURVEILLANCE PROGRAMMES

Preparedness for Mpox Outbreak

In 2022, there was a rise in the number of mpox cases in countries beyond the endemic countries in Africa. Across 50 countries in five World Health Organization (WHO) regions, more than 3,000 mpox cases were reported in June 2022. As part of preparedness, NPHL conducted laboratory training and safety briefings to technical staff and increased the pool of trained medical technologists able to perform PCR and sequencing for mpox. With timely preparation, NPHL detected Singapore's first imported mpox case on 20 June 2022.

NPHL collaborated with MOH Communicable Disease Division to establish the protocol for the Department of Sexually Transmitted Infections Control (DSC) Clinic to send mpox-suspected samples directly to NPHL. This direct testing workflow took effect on 15 August 2022.

Enhanced Acute Respiratory Infection / Influenza-like Illness Surveillance in Dormitory Clinics and Polyclinics

To monitor the circulating SARS-CoV-2 variants and detect emergence of new ones, NPHL worked with MOM ACE, MOH, National Healthcare Group Polyclinics, National University Polyclinics and SingHealth Polyclinics to enhance surveillance sampling since June 2021. Sentinel surveillance for influenza and acute respiratory infections in the community were enhanced to provide more information on the range of pathogens detected.

A senior medical technologist working with isolates to perform tests as part of surveillance and outbreak investigation

Laboratory results of the samples taken from dormitory clinics and polyclinics, including those from PCR tests and WGS, were analysed together with available epidemiological information to support MOM ACE and MOH in their assessment of various respiratory infections, in the endemic phase of COVID-19.

Continuing National Surveillance and Outbreak Investigations

NPHL continued laboratory surveillance on enteroviruses and vector-borne viruses such as dengue, chikungunya, Zika, as well as supported the national tuberculosis and HIV programmes.

The country observed an increase in foodborne outbreaks and re-emergence of respiratory pathogens. NPHL assisted MOH and public healthcare institutions in their investigations of clusters due to *Burhholderia cepacia*, *Pseudomonas aeruginosa*, *B. pseudomallei*, and *S. Typhi*.

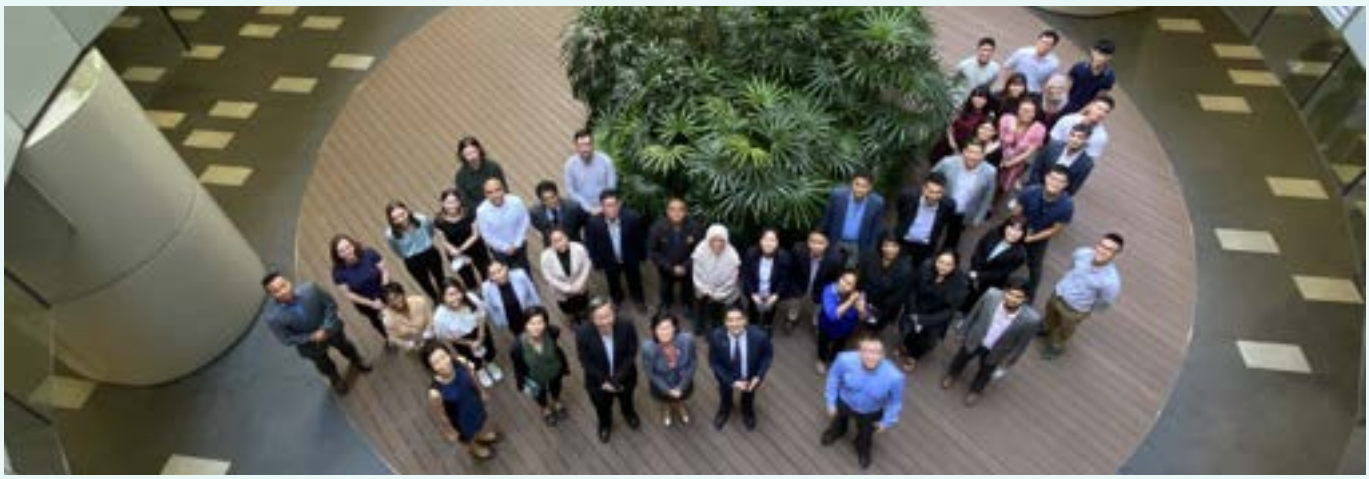
NPHL continued to enhance preparedness for dealing with exotic and highly dangerous pathogens. The team responded to a suspect case by conducting early rule-out investigations and eventually detected the cause as malaria.

INTERNATIONAL ENGAGEMENTS

The battle against COVID-19 around the world has highlighted the importance of international cooperation and scientific collaboration. To contribute to the regional and international laboratory community and benefit from the sharing by counterparts in various countries, NPHL has ongoing engagements with WHO, ASEAN and the Regional Public Health Laboratory Network under GHSA.

One example of such cooperation and collaboration was the Bioinformatics Workshop, co-organised by the UK Health Security Agency's New Variant Assessment Platform (NVAP), WHO Regional Offices, NPHL and IDRTO. Held from 28 November to 2 December 2022 in NCID, the inaugural five-day workshop hosted 19 participants from countries in the WHO's Western Pacific Region (WPRO) and Southeast Asia including Bangladesh, Bhutan, Cambodia, Indonesia, Malaysia, Maldives, Mongolia, Nepal, the Philippines, Sri Lanka and Thailand. It was the first face-to-face WGS workshop held in Singapore and the region since the start of the COVID-19 pandemic.

The workshop included lectures, laboratory practicals, demonstration sessions and classroom tutorials. The attendees experienced sequencing SARS-CoV-2 samples on the Nanopore platform for the first time, conducted troubleshooting and used different bioinformatics tools to analyse the results. The trainers of this workshop included experts from the United Kingdom, Singapore and Asia Pacific



The Bioinformatics Workshop was co-organised by the UK Health Security Agency's NVAP, WHO Regional Offices, NPHL and IDRTO and hosted 19 participants from countries in the WHO's WPRO and Southeast Asia

Genomics Network (APGN) trainers from the Peter Doherty Institute, Australia.

Participants also shared their experience and challenges in SARS-CoV-2 variant monitoring with NVAP and WHO, and provided valuable feedback which will enable WHO, NVAP and APGN to plan their activities in the coming years.

NPHL is represented in several global and regional networks. In 2022, it participated in:

1. Regional Public Health Laboratory Network under the GHSA, where NPHL participated in monthly virtual meetings;
2. Laboratory Expert Workgroup for COVID-19 under WHO HQ, where NPHL participated in regular meetings;
3. Pathogen Genomics Meetings of WHO WPRO, where at this platform, Dr Cui Lin, Senior Principal Scientific Officer, NPHL was appointed Temporary Advisor to the meetings. This major initiative of the regional office supports the new global WHO Pathogen Genomics strategy;
4. APGN, where NPHL aims to build regional capacity and enable sharing of pathogen genomics among public health laboratories, which is essential for future responses to communicable diseases outbreaks. NPHL is one of the founding members and member of the Steering Committee;
5. WHO HQ Panel for revising IHR indicators; and
6. Regional WHO Meetings for influenza and measles.

Standard Material Transfer Agreement 1 with WHO

To facilitate the contribution of biological specimens to the WHO Biohub, a Standard Material Transfer Agreement (SMTA) 1 was signed by NPHL and WHO on 14 November 2022. The WHO BioHub System serves as a repository of pathogens and their variants with epidemic or pandemic potential that can be safely shared with laboratories around the world. The sharing would be done through one (or more) of the laboratories designated as a WHO BioHub facility, and would allow WHO Member States and partners to advance research, be more prepared for health emergencies, and ensure fairness in access to benefits arising from this sharing.

Ten days after the SMTA 1 was signed, NPHL sent two XBB isolates to the WHO BioHub Facility, Spiez Laboratory on 24 November 2022. NPHL is one of the earliest contributors to the BioHub.

Summary:

1. **NPHL's continual efforts in monitoring potential variants of concerns will assist MOH to swiftly introduce mitigation measures should an outbreak occur.**
2. **As part of preparedness for mpox, NPHL conducted laboratory training and safety briefings to technical staff and increased the pool of trained medical technologists able to perform PCR and sequencing for mpox.**
3. **The five-day Bioinformatics Workshop, co-organised by the UK Health Security Agency's NVAP, WHO Regional Offices, NPHL and IDRTO was the first face-to-face WGS workshop held in Singapore and the region since the start of the COVID-19 pandemic.**

Contributed by:
Adj Prof Raymond Lin, Director, NPHL and Mr Roger Chua, Laboratory Manager, NPHL

SURVEILLANCE AND DISEASE CONTROL

FOR A HEALTHIER SG

ENDING HIV AND TB AS PUBLIC HEALTH THREATS

Adj Asst Prof Wong Chen Seong,
Deputy Director, National HIV Programme

At the National Centre for Infectious Diseases (NCID), the national public health programmes – the National HIV Programme (NHIVP) and the National Tuberculosis Programme (NTBP) – collaborate and partner with the National Public Health and Epidemiology Unit (NPHEU) and National Public Health Laboratory (NPHL) to end human immunodeficiency virus (HIV) and tuberculosis (TB) as public health concerns.

HIV remains a pressing public health concern globally, with 1.5 million cases diagnosed worldwide in 2021[1]. In Singapore, there were 250 cases of newly-diagnosed HIV infections, of which 62 per cent were diagnosed at a late stage of disease[2], wherein they had a more extensive degree of immune-compromise and hence were at risk of poorer outcomes. While there has been a general downward trend in the incidence of HIV infections in recent years, more can still be done to reduce the number of new infections, increase voluntary HIV testing and hence reduce late presentations, as well as combat HIV-related stigma – all of which will go a long way in ending HIV as a public health concern.

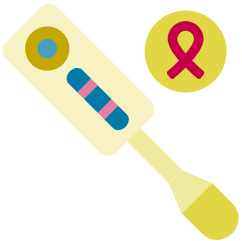
Since 2008, the incidence rates of TB among Singapore residents have remained between 35 and 40 per 100,000 population. Although there has been a gradual decline in the TB incidence rate among residents from 38.7 per 100,000 population in 2018 to 32.6 per 100,000 population in 2021, this decrease could be partly attributed to the effects of COVID-19. If we are to achieve a TB-free Singapore, greater efforts are needed to see a sustained reduction in the incidence rates.

The partnerships with NPHL and NPHEU have enabled the two national public health programmes to take an evidenced-informed approach to derive new strategies and analyse data to guide policies.

MULTI-DIMENSIONAL EFFORTS TO END HIV IN SINGAPORE

Reducing the number of new HIV infections is a complex and multi-dimensional effort. First, it requires a deeper understanding of the way in which HIV is transmitted in the community, particularly among key affected populations most at risk of HIV, so that targeted and specific interventions may be implemented. To this end, one of the key tools employed is HIV recency assays. These assays are designed to detect recently acquired HIV infections on a population level using one or more biomarkers such as antibody avidity, relying on the understanding of the immune response maturation over time following an initial infection. The usage of such assays remains essential for surveillance and assessing interventions. It can also lead to the identification of epidemiologically linked clusters of recent infections or subpopulations with ongoing or emerging transmission. This would help to inform HIV prevention, testing and partner notification or contact tracing.

In NPHL, recency testing is conducted on residual plasma from newly-diagnosed HIV-positive individuals as part of the national HIV Molecular Surveillance Programme since 2012. Working together with NPHEU, NPHL identified risk factors associated with recent infections in a study[3] involving 701 HIV-positive newly-diagnosed individuals between 2013 to 2017. A significantly higher proportion of recent infections were observed in men having sex with men than with heterosexual men (23.4 per cent vs 11.1 per cent). Other independent factors associated with recent infections were younger men (15 to 24 years), HIV diagnosis in more recent years (2015 and 2017), detection via voluntary testing and history of HIV test(s) prior to positive diagnosis.



Enhancing HIV testing in general is also essential to national HIV efforts. Testing and diagnosis represent the first step in the HIV care continuum, allowing people who are infected to be linked to life-saving antiretroviral therapy (ART), as well as presenting opportunities for those who are HIV-negative but who are still at risk of infection to be provided with education and resources to stay uninfected. The NHIVP and NPHL worked closely together by implementing changes to the existing HIV diagnostic landscape. This was made possible by adopting newer laboratory tests that can lead to faster testing services and higher volume of accurate results. These include moving away from western blotting to include more rapid enzyme immunoassays and the application of nucleic acid test to readily identify acute infections. The application of new tests into the current testing algorithm also meant modifying the testing algorithm to allow reflex testing in a variety of settings to minimise time to treatment. In addition, the NHIVP and NPHEU also partnered with external key stakeholders like Action for AIDS (AfA) and Department of Sexually Transmitted Infections Control (DSC) Clinic to implement the HIV self-testing pilot programme in Singapore, with the aims of introducing HIV self-testing to the local population.

HIV treatment today is highly efficacious, safe and widely accessible. Guidance in the use of ART in Singapore is provided by the National ART Recommendations developed by NHIVP. The choice of which regimens to be recommended as first-line therapy is determined by a number of factors, including the prevalence of transmitted HIV drug resistance (TDR) in the local setting. TDR can lead to delayed viral suppression or treatment failure for individuals starting ART and pre-exposure prophylaxis (PrEP). Viral resistance to ART and PrEP arise from mutations transmitted at the time of infection or acquired during exposure to sub-optimal drug levels. This resistance affects all major drug classes and is a threat to the elimination of HIV. By using residual plasma obtained from newly-infected HIV-positive individuals without prior ART, NPHL carries out drug resistance genotyping to routinely monitor TDR using Sanger and next-generation sequencing technologies. The overall TDR prevalence is reported to the Ministry of Health (MOH) as part of the national HIV Molecular Surveillance

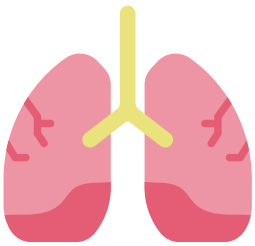
Dr Carmen Low,
Senior Scientific Officer, National Public Health Laboratory

Dr Deborah Ng,
Deputy Director, National Tuberculosis Programme

> The partnerships with NPHL and NPHEU have enabled the two national public health programmes to take an evidenced-informed approach to derive new strategies and analyse data to guide policies.

Programme and is published in MOH's annual Communicable Diseases Surveillance report. NPHL's surveillance showed overall TDR prevalence increased from 3.3 per cent to 7.5 per cent since starting in 2012, with non-nucleoside reverse transcriptase inhibitors (NNRTIs) providing the largest contribution. NHIVP organises workshops and symposiums since 2019 to share with HIV care practitioners on TDR prevalence to major drug classes. Local TDR prevalence rates provided a data-driven approach to modify HIV treatment regimens, switching from NNRTI to Integrase Strand Transfer Inhibitor (INSTI)-based primary drug regimen. In addition, laboratory results are also shared with our counterparts from participating hospitals in the HIV Molecular Surveillance Programme to enhance primary care for HIV patients.

WORKING TOGETHER TO FURTHER REDUCE TB INCIDENCE RATES



Since November 2020, all isolates of *Mycobacterium tuberculosis complex* have been sent for whole genome sequencing (WGS) to the NPHL. The NPHL then provides a list of the genetic clusters to the NTBP on a weekly basis. The clusters are matched with the cases in the National TB Registry and conveyed to the public health officers for epidemiological investigation. These clusters are presented on a weekly basis at meetings with NPHL, in order to provide further insight and expertise. Based on NTBP's experience of the epidemiological investigations to date, the programme worked with NPHL to refine its threshold on the definition of clustering and was able to fine-tune protocols to provide greater acuity and efficiency in conducting epidemiological investigations. One such example is the mass screening exercise conducted in Jalan Bukit Merah in 2022, where a WGS cluster of seven TB cases was detected. The screening exercise led to the detection of an additional 15 cases of active TB disease, and nearly 200 cases of latent TB infection.

In October 2022, the NTBP invited five international TB experts to conduct a review of the TB programme, to help identify gaps in existing policies, and to recommend strategies that would help the NTBP achieve its goal of reaching an incidence rate of less than 10 per 100,000 population by 2040. NPHEU served as the secretariat and conducted risk factor analysis for the review.

Multisectoral accountability is one of the key pillars of the World Health Organization's End TB strategy. Similarly, the reduction in TB incidence cannot be achieved by the efforts of the NTBP alone, but requires close collaboration with multiple stakeholders and partners. NTBP endeavours to continue to build on these relationships in order to achieve the common goal of ending TB in Singapore.

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2. CD4+ cell count of less than 200 per cu mm or AIDS-defining opportunistic infections or both
3. Ang, L.W., Low, C., Wong, C.S. et al. Epidemiological factors associated with recent HIV infection among newly-diagnosed cases in Singapore, 2013–2017. BMC Public Health 21, 430 (2021). https://doi.org/10.1186/s12889-021-10478-5Epidemic intelligence service training is designed to meet the challenging future of health emergency preparedness.

NATIONAL PUBLIC HEALTH AND EPIDEMIOLOGY UNIT

The National Public Health and Epidemiology Unit (NPHEU) works closely with national and international partners to support the Ministry of Health (MOH) in the prevention, surveillance, and response to communicable diseases outbreaks in Singapore.

INTRODUCTION

NPHEU provides expertise in horizon scanning, epidemiological investigations, data analytics, and sense-making of communicable diseases. Specifically, it:

- Provides the evidence base for National HIV and Tuberculosis (TB) Programmes and national strategies for the prevention and control of communicable diseases;
- Provides long-term horizon scanning and risk assessments on infectious threats for clinical and public health practice guidance;
- Conducts national surveillance and audits on healthcare-associated infections, antimicrobial stewardship, and infection prevention and control; and
- Strengthens the linkage between expertise in public health and epidemiology and policy development.

EPIDEMIOLOGICAL ANALYSES

Daily Situation Dashboard for COVID-19

To guide resource planning for timely patient care, the NPHEU Data Team developed a real-time COVID-19 dashboard comprising clinical and operational data with forecasting. The dashboard provides key information on the number of COVID-19 patients in NCID wards, patterns on inflow and outflow of patients, bed occupancy rates, and severe cases in the intensive care unit, high dependency and or requiring oxygen in the general ward.

The dashboard was put together based on collated data from multiple sources and was processed through Tableau workflows for daily visualisation. In 2022, the dashboard underwent an enhancement to include data on other infectious diseases such as dengue.

NPHEU team in discussion on the global situation of COVID-19 cases

Emerging Infectious Diseases Situation Update

Since 2020, NPHEU has been providing emerging infectious diseases (EIDs) situation updates to infectious disease physicians and public health professionals. This information on the latest global and local EIDs situation will help in assessing the risks to Singapore's healthcare system, evaluating emerging trends and risks of EIDs, and developing infection preventive and control strategies.

In 2022, NPHEU conducted 32 presentations of EIDs situation update based on horizon scanning and literature review. In addition to COVID-19, other infectious diseases that NPHEU closely monitored were dengue, mpox, severe acute hepatitis of unknown aetiology in children, Sudan Ebola Virus Disease and Middle East Respiratory Syndrome that were essential for clinical and public health practice guidance.

CONTRIBUTIONS TOWARDS NATIONAL SURVEILLANCE EFFORTS

Severe Illness and Death from Possibly Infectious Causes Programme

Established in 2009, the Severe Illness and Death from Possibly Infectious Causes (SIDPIC) programme is a hospital-based surveillance initiative that reviews cases of unexplained deaths and critical illnesses to facilitate the early identification of emerging or re-emerging pathogens of public health importance. Currently, there are eight hospitals in Singapore participating in the programme.

As the secretariat, NPHEU's responsibilities include preparing bi-weekly reports and coordinating quarterly meetings for the national SIDPIC Committee, providing comprehensive analysis of SIDPIC indicators, facilitating discussion of positive infectious pathogens identified among SIPIDC cases, conducting encephalitis syndromic surveillance, and addressing SIDPIC committee recommendations for follow-up. Further analysis was also performed to verify signals detected in the review of data relating to the cases recruited under the programme.

From 2022, weekly checkpoint meetings were held between NPHEU secretariat members and the SIDPIC Committee Chairman Assoc Prof Ng Oon Tek to discuss and implement workflow changes and new initiatives to improve operational efficiency as well as enhance signal detection capacity of the programme. NPHEU also contributed to the SIDPIC section in MOH's Communicable Disease Division annual report.

National Committee for the Certification of Poliomyelitis Eradication

The National Committee for the Certification of Poliomyelitis Eradication (NCC) was established in 1996 in accordance with the recommendations of the Regional Commission for the Certification of Poliomyelitis Eradication in World Health Organization's (WHO) Western Pacific Region (WPRO). The NCC advises MOH on Singapore's polio programme to ensure that it meets WHO's criteria to a certification standard for the maintenance of polio-free status.

As secretariat, NPHEU completed the analysis of acute flaccid paralysis surveillance data and drafted the annual progress report in 2022. The team coordinated the annual NCC Committee meeting on 16 August 2022, where attendees were updated on the global and regional situation, and Singapore's progress in sustaining its polio-free status was reviewed. Post-meeting, the secretariat team revised the annual progress report before its submission to WPRO.

National Verification Committee for Measles and Rubella Elimination

The National Verification Committee for Measles and Rubella Elimination (NVC) was established in 2014 in accordance with the recommendations of the Regional Verification Commission for Measles and Rubella Elimination in WPRO. The NVC advises MOH on the requirements for verification of measles and rubella elimination in Singapore in support of WHO's goals for measles and rubella elimination in the Region. As secretariat, NPHEU completed the analysis of measles and rubella surveillance data for 2021, drafted the annual progress report, and coordinated and facilitated the annual NVC Committee meeting on 12 May 2022. At this meeting, the NVC Committee reviewed Singapore's progress made in 2021 and advised MOH to apply for rubella elimination based on lines of evidence. Post-meeting, the team compiled inputs from stakeholders, revised the annual progress report, and ensured timely submission to WPRO.

On 16 September 2022, WPRO announced that Singapore had eliminated rubella.

CONTRIBUTIONS TOWARDS VACCINE INJURY FINANCIAL ASSISTANCE PROGRAMME FOR COVID-19 VACCINATION

The national Vaccine Injury Financial Assistance Programme (VIFAP) for COVID-19 Vaccination was implemented to provide a one-time goodwill financial assistance to persons who received the COVID-19 vaccines under the National Vaccination Programme and in accordance with the recommendations of the Expert Committee on COVID-19 Vaccination, and had experienced serious side effects that are assessed to be related to the COVID-19 vaccines that were administered in Singapore. As secretariat, NPHEU coordinated and hosted seven VIFAP panel meetings in 2022. Post-meeting, NPHEU updated the VIFAP panel decisions, obtained endorsements from relevant stakeholders and delivered timely submission of the finalised assessment report to MOH's Deputy Director-General of Health (Public Health Group).

NATIONAL HIV SURVEILLANCE

UNAIDS Global AIDS Response Progress Report

NCID is the Country Liaison responsible for providing national statistics on human immunodeficiency virus (HIV). NPHEU collated statistical data on HIV and other sexually transmitted infections from various healthcare providers and stakeholders for the Reporting Year 2021 to submit to the annual UNAIDS Global AIDS Monitoring Progress Report. Additionally, as the custodian of Singapore's National HIV Registry, NPHEU also promptly investigated all newly diagnosed cases of HIV and performed contact tracing of high-risk individuals to stem further transmission.

World AIDS Day Report and Annual HIV Update

In support of the World AIDS Day Report and Annual HIV Update, NPHEU carried out public health research on HIV epidemiology and risk behaviours to develop and improve preventive strategies. It also completed the assessment and update of key HIV notification indicators and incidence trends, distribution rates and contact tracing under its HIV surveillance programmes. The information was submitted to MOH to support the development of preventive and educational measures for HIV/AIDS.

HIV Surveillance Programmes to Monitor Testing Trends

During the year, NPHEU continued to support critical national HIV surveillance programmes set up by MOH to collect epidemiological information from various participating hospitals and agencies for the monitoring of HIV infection trends nationally. By tracking HIV testing trends in Singapore and assessing prevention and management measures, the data gathered was used to guide national policies and programmes for HIV/AIDS.

The four surveillance programmes are:

Anonymous Testing Scheme

- Introduced in 1991 to encourage HIV testing
- Anonymous screening is available at nine private clinics and Action for AIDS

Antenatal Screening Programme

- Set up in 1998 to facilitate early diagnosis during pregnancy so that preventive therapy can be administered to prevent possible mother-to-child transmission

Voluntary Opt-Out Screening Programme

- Implemented in 2008 for adult inpatients in public hospitals
- Aims to improve detection rates and reduce the prevalence of undiagnosed and late-stage diagnosis HIV infection

Men who have Sex with Men (MSM) Seroprevalence Survey

- Community-based project set up to increase anonymous HIV and syphilis testing among those in the target group aged 18 years old and above
- Aims to provide cross-sectional data on HIV and syphilis prevalence among MSM in Singapore
- The 9th Survey was conducted between December 2020 to July 2021. NPHEU cleaned the data and performed in-depth analysis. The data analysis and key findings were presented at the National HIV Policy Committee meeting on 26 May 2022.

SUPPORTING THE NATIONAL TB PROGRAMME

NPHEU's involvement in Singapore's TB surveillance in 2022 included providing in-depth data analysis to the National Tuberculosis Programme (NTBP) in the form of risk factor analyses and study methodologies.

From 11 to 13 October, a three-day International Review Panel convened at NCID to review Singapore's TB prevention and care measures. The panel's objective was to critically evaluate the measures to identify gaps and areas for improvement, as well as recommend policy improvements that will put the NTBP on the right track towards achieving the 20-10-10-20 targets set by MOH.

As the secretariat for the International Review Panel meeting, NPHEU conducted risk factor analysis for the programme review, coordinated the invitation of local panel members, prepared daily minutes during the review period, as well as drafted the review report and slides for the International Review Panel's inputs and recommendations.

HEALTHCARE-ASSOCIATED INFECTIONS SURVEILLANCE

Given the constant movement between patients and practitioners in healthcare settings, it is important to strengthen Infection Prevention and Control (IPC) efforts to address healthcare-associated infections (HAIs) holistically. In this regard, the NPHEU HAI Surveillance Unit conducts regular surveillance and audits on IPC activities and antimicrobial utilisation (AMU) at public hospitals in Singapore.

Staff from NPHEU HAI Surveillance Unit in a discussion

AMU Surveillance in Singapore's Public Health Institutions

To assess the utilisation and identify improvement strategies, an independent AMU audit was commissioned by the National

2022 Case Study Highlights

During the year, NPHEU furthered the Singapore medical community's understanding of HIV and accompanying risks by conducting two noteworthy case studies.

	Case Study #1	Case Study #2
Title of Case Study	Study of Potential Markers of HIV-related Risks in MSM in Singapore Applying Latent Class Analyses Methodology to Seroprevalence Survey Data	Study of Determinants of Influenza Vaccination among People Living with HIV (PLHIV) under the care of NCID
Led by	Dr Isabel Tavitian-Exley, Principal Epidemiologist, NPHEU and Dr Hao Ying, Principal Medical Statistician, NPHEU	Adj Asst Prof Wong Chen Seong, Head, NCID HIV Programme; Dr Chow Chiaw Yee, Deputy Head, NCID HIV Programme; and Dr Isabel Tavitian-Exley, Principal Epidemiologist, NPHEU
Purpose of the Case Study	Low-level HIV epidemic settings like Singapore face the challenge of effectively reaching individuals who engage in high-risk behaviours yet are less engaged with prevention programmes. NPHEU collaborated with NHIVP to apply latent class analyses methodology to seroprevalence survey data. The hypothesis is that the pattern of meeting platforms used by men who have sex with men to find their sexual partners could serve as potential marker(s) of risk to differentiate sub-groups among them and inform more targeted efforts and interventions. The findings from this study will be shared with policy makers and scientific fora.	This study aimed to identify factors associated with adherence to influenza vaccination among PLHIV and to explore strategies to improve vaccination uptake in this population. Preliminary findings have suggested that nurse-led counselling for vaccination and public messaging may help increase annual vaccination uptake, though financial constraints remain an issue. Resuming nurse-led vaccination and expanding government subsidies to include other key vaccinations for PLHIV regardless of residency status could improve overall vaccination coverage. The study was the first to be conducted in a Southeast Asian context. Preliminary findings were produced and used to inform the NCID HIV Programme, and an abstract was submitted to the 2023 International AIDS Society conference.

Antimicrobial Resistance Control Committee. The audit was conducted between January to August 2022 in all public acute hospitals by surveillance coordinators from NPHEU HAI Surveillance Unit. They were trained for the audit based on the Global Point Prevalence Survey (Global PPS) method by Mr Kyaw Zaw Linn, Senior Coordinator and Dr Kalisvar Marimuthu, Clinical Lead from NPHEU HAI Surveillance Unit who are also trained for regional Global PPS.

Epidemiology Analysis of Healthcare-associated Infection – Point Prevalence Survey

The NPHEU HAI Surveillance Unit conducts a regular PPS on HAI and AMU to identify several priority areas for quality improvement, in particular the prevalence of patients with HAIs and/ or AMU, unspecified sepsis and device-associated infections. The PPS is conducted at periodic intervals nationwide, to monitor local HAI and AMU trends and to measure the impact of interventions where the independent baseline has been established. A total of 12 hospitals across the nation have been actively involved in this survey.

In 2022, NPHEU conducted statistical analysis for Tan Tock Seng Hospital to describe the distributions of HAI and antimicrobial resistance.

Study on Viable Mpox Virus in a Patient Room Environment

Together with the National Environmental Agency, a study was conducted by NPHEU HAI Surveillance Unit to pinpoint the extent of surface contamination in the hospital room occupied by a mpox-positive patient. Areas of focus included the chair, toilet seat, and dust from the bed linen. Results revealed that while the virus was detected in almost all air samplers, they were not culturable, and that surface, dust and air contamination gradually declined after the first week of illness.

The manuscript of the study has been published in the *International Journal of Infectious Diseases*.

Systematic Review of Literature for Environmental Cleaning Technologies

The state of the physical environment in healthcare settings directly impacts the prevention and control of HAIs. Hence, NPHEU HAI Surveillance Unit embarked on an MOH-commissioned systematic review of literature for environmental cleaning technologies. The review aimed to:

1. Propose strategies to effectively deploy new technologies and innovations for environmental cleaning in different healthcare settings;

2. Identify technologies and innovations that are at pre-deployment stage;
3. Identify research gaps related to environmental cleaning processes, technologies and innovations in Singapore.

Impact of COVID-19 on Carbapenem-resistant Enterobacterales Incidence in Asia-Pacific

From June to November 2022, NPHEU HAI Surveillance Unit assessed the impact the COVID-19 pandemic had on carbapenem-resistant enterobacterales (CRE) incidence in hospitals around the Asia-Pacific region. Using interrupted time series analysis, the team discovered that participating sites had a significant decline in CRE incidence, which was mainly attributed to a reduction in CRE from surveillance cultures.

An abstract of the study has been submitted to the 33rd European Congress of Clinical Microbiology & Infectious Diseases 2023 for oral presentation.

INTERNATIONAL PARTNERSHIPS

Clinical, Research, Epidemiology, Education and Diagnostics Meetings

Clinical, Research, Epidemiology, Education and Diagnostics (CREED) is a platform for sharing regular updates, findings and insights on infectious diseases by clinical teams, epidemiology and public health professionals in NCID and the larger healthcare community that specialises in infectious diseases across Singapore. NPHEU has been actively inviting speakers and facilitating the virtual meetings attended by healthcare professionals across various disciplines such as medicine, pharmacy, nursing, laboratory, research, epidemiology and public health to acquire new updates on infectious disease topics of current or future interest and importance.

Each monthly meeting (extended to bi-monthly on occasion) has hosted an average of 80 to 120 participants, some of whom have included international colleagues from Brunei's Ministry of Health, Thailand's Bamrasnaradura Infectious Diseases Institute, and South Korea's National Medical Center.

Key highlights from the 2022 meetings included sharings by seven overseas colleagues such as Prof Peter Piot, former Director of the London School of Hygiene and Tropical Medicine and Founding Executive Director, UNAIDS; Prof Heidi Larson, Founding Director of the Vaccine Confidence Project, London School of Hygiene and Tropical Medicine; and Prof Azra Ghani, Professor of Infectious Disease Epidemiology, Imperial College London on their work in various aspects of infectious diseases, global health and biosurveillance.

Summary:

1. **A real-time COVID-19 dashboard comprising clinical and operational data was developed by the NPHEU Data Team in an effort to guide resource planning for timely patient care.**
2. **NPHEU conducted regular surveillance and studies to strengthen IPC efforts across healthcare settings in Singapore to address HAI holistically.**
3. **The virtual CREED meetings provided a platform for local and international infectious diseases professionals to acquire new updates on topics of current or future interest and importance.**

Contributed by:

Adj Assoc Prof Matthias Paul Toh, Director, NPHEU; Dr Irving Boudville, Senior Consultant, NPHEU; Dr Calvin Chiew, Associate Consultant, NPHEU; Dr Isabel Tavitian-Exley, Principal Epidemiologist, NPHEU; Dr Gao Qi, Senior Epidemiologist, NPHEU; Ms Soong Ai Jia, Senior Epidemiologist, NPHEU; Ms Jacqueline Teoh Pui Li, Senior Epidemiologist, NPHEU; Dr Santhya, Senior Epidemiologist, NPHEU; Ms Eve Nah Puay Hoon, Assistant Manager, NPHEU; Ms Shannon Low Hui Ching, Coordinator, NPHEU; and Mr Kyaw Zaw Linn, Senior Coordinator, NPHEU HAI Surveillance Unit

NATIONAL HIV PROGRAMME

The National HIV Programme (NHIVP) employs a multidisciplinary approach to coordinate the national response to manage human immunodeficiency virus (HIV) infections through quality and holistic patient-centred care whilst developing and implementing local guidelines to support the goal of ending HIV in Singapore.

INTRODUCTION

The National HIV Programme (NHIVP) aspires to achieve the Ministry of Health's (MOH) objectives of ending HIV in Singapore by:

- Coordinating the formulation and recommendation of evidence-based guidelines on HIV testing, prevention, treatment and patient management;
- Monitoring HIV trends in Singapore through working with the National Public Health and Epidemiology Unit (NPHEU) to conduct surveillance of HIV and sexually transmitted infections (STIs);
- Providing enhanced training to healthcare professionals to strengthen their competence and confidence in the management of patients with HIV; and
- Developing HIV education campaigns to increase awareness and reduce HIV-related stigma.

UNAIDS 90-90-90 TREATMENT TARGETS AND BEYOND

In 2020, Singapore achieved the treatment target of 83-94-95. Although the achievement of the first target – the proportion of people living with HIV (PLHIV) who know their HIV status – fell short by 7 per cent, the second and third targets were surpassed as the results showed that 94 per cent of diagnosed PLHIV were on antiretroviral treatment, and 95 per cent of those on antiretroviral therapy were virally suppressed. Overall, about 75 per cent of the population with HIV in Singapore had achieved viral suppression, which is above the threshold set by the Joint United Nations Programme on HIV/AIDS (UNAIDS) to reduce onward transmission and end the HIV/AIDS epidemic.

NHIVP will continue in its efforts and work closely with NPHEU and the Enhanced HIV Programmes (EHIVP) at National University Hospital (NUH), Singapore General Hospital (SGH), Changi General Hospital (CGH) and NCID to monitor the KPIs related to HIV clinical care in order to achieve the new UNAIDS target of 95-95-95 by 2025.

To further aid in Singapore's progress towards the 95-95-95 target, CGH has been added as the fourth site of the EHIVP in April 2022. CGH's robust and comprehensive clinical HIV programme that serves the east catchment area will complement the NHIVP's goal of combating HIV in Singapore.

EDUCATION AND OUTREACH EFFORTS

HIV Community Engagement Forum 2022: Ins & Outs of HIV Testing

Jointly organised by NHIVP and the Training and Education office under the Infectious Disease Research and Training

The 2022 virtual edition of HIV Community Engagement Forum discussed the ins and outs of HIV testing, with guest speakers from AfA and Dr Tan & Partners Clinic

Office (IDRTO), the goal of the HIV Community Engagement Forum has been to engage the public in dialogues and discussions to raise awareness on HIV stigma and discrimination, and combat misconceptions surrounding HIV in Singapore.

The 2022 edition on 24 September brought together 160 participants virtually as they discussed the ins and outs of HIV testing, as well as the next steps after. Guest speakers Ms Sumita Banerjee, Executive Director, Action for AIDS (AfA) and Dr Jonathan Ti, Chief Medical Officer, Dr Tan & Partners Clinic, who touched on the different HIV testing services in Singapore, ranging from rapid testing to the newly introduced self-testing kits under the HIV self-testing pilot programme were also present. A post-event survey found that the forum helped refresh the knowledge of professional practices and provided them with updates on the currently available HIV testing options.

HIV PrEP Prescriber Course 2022

To further enhance the knowledge and skill sets of general practitioners and healthcare professionals who administer Pre-Exposure Prophylaxis (PrEP) services, the virtual HIV PrEP Prescriber Course was jointly organised by IDRTO and NHIVP. It involved a multidisciplinary expert panel of speakers covering topics such as the science behind PrEP, sexual health, challenges when prescribing PrEP, and general practitioner perspectives on PrEP implementation. Information on the NCID PrEP Care Clinic services was also shared. Over 230 participants comprising doctors, nurses, pharmacists, and allied health professionals, attended the course.

National HIV Campaign

From 1 December 2022 through end-March 2023, NHIVP co-fronted the National HIV Campaign alongside the Health Promotion Board (HPB) and stakeholders, including AfA, Department of Sexually Transmitted Infections Control (DSC) Clinic, NUH, SGH and Singapore National Employers Federation (SNEF). In line with the NHIVP's HIV Testing Recommendation, the campaign was themed "Know Your Status." NHIVP's involvement in the campaign as content lead emphasised the importance of knowing one's HIV status by tapping platforms such as *CNA Online*, *The Daily Ketchup* video podcast and *King Kong Media Production*.

Roll-out of HIV Self-Testing Pilot Programme

In Singapore, most newly diagnosed HIV infections continue to be detected during clinical care and typically at a late stage of infection, with a very low proportion diagnosed from self-initiated testing. In addition, the National HIV Testing Recommendations recommend that every adult aged 21 years and above should be tested at least once in their lifetime, regardless of risk factors, and people at higher risk of HIV infection should be tested more frequently.

NHIVP introduced the HIV Self-Testing (HIVST) Pilot Programme in August 2022 to complement the existing testing modalities. With HIVST, one can test for HIV in the privacy of their home through the self-collection of oral specimens using a swab. In support of the programme, NCID rolled out a series of publicity efforts through digital mediums such as social media channels and hardcopy formats such as posters, to announce the availability of the self-test kits and encourage take-up.

As of 31 December 2022, over 650 HIVST kits were sold to over 350 unique buyers. The preliminary data has also shown that the HIV self-test kits are safe, easy to use, and attracted those who have never done an HIV test, with almost 1 in 3 being first-time testers. With the introduction of HIV self-testing in Singapore, NHIVP aims to increase access to testing services, encourage individuals at risk to be tested and seek early treatment if the result is positive. Under the pilot, HIV self-testing kits can be purchased from DSC Clinic and AfA. Further evaluations and assessments will be done to evaluate the feasibility of a wider national roll-out in the future.

NCID rolled out a poster to announce the availability of the self-test kits and to encourage take-up

DEVELOPMENT OF NATIONAL RECOMMENDATIONS FOR HIV MANAGEMENT

One of NHIVP's core functions is to develop evidence-based recommendations and guidelines for HIV management that are aligned with clinical evidence and international guidelines. The purpose of these recommendations would be to assist healthcare providers in their practice of HIV testing, prevention, treatment, and patient management, as well as to train new HIV specialist trainees at educational webinars and conferences.

The second iteration of the National Antiretroviral Therapy (ART) Recommendations and PrEP Guidance were submitted to the *Singapore Medical Journal* (SMJ) for publication for wider dissemination, while the first edition of the HIV Testing Recommendation manuscript was accepted by SMJ, pending publication.

Meanwhile, NHIVP convened a team of healthcare specialists from various disciplines and representatives from EHIVP and the National Tuberculosis Programme to develop the first draft of the Primary Care Recommendations for People Living with HIV. The workgroup referenced international and local guidelines, screened them for conflict of interest and agreed on a consensus suited for the local context. These guidelines were submitted to MOH for review and approval for national circulation and implementation.

NHIVP also conducted a voluntary NHIVP ART Recommendation Adherence Survey among ART prescribers in public and private healthcare institutions to measure the reach and adoption of the National ART Recommendations and prescriber attitudes towards the recommendations. Results revealed the following:

- 88.5 per cent initiated ART for their patients within 14 days of their first clinic visit
- 95.8 per cent prescribed Integrase inhibitor-based regimen as the preferred first-line ART regimen
- 91.7 per cent agreed that early initiation of ART could slow the spread of HIV in a community by making patients less infectious to others
- 23.4 per cent reported the need to address opportunistic infections before starting ART

On the whole, the National ART Recommendations were positively received. Close to 85 per cent were aware of the recommendations and believed that working according to these recommendations would lead to improved patient care, with 79.2 per cent reporting that they would adhere to the National ART Recommendations for their practice.

NCID HIV PROGRAMME

The NCID HIV Programme provides high-quality, evidence-based clinical care for the largest cohort of people in Singapore who are living with HIV. Guided by UNAIDS 90-90-90 targets to end the HIV epidemic, the NCID HIV Programme aims to achieve the following:

1. 90 per cent of all PLHIV knowing their diagnosis;
2. 90 per cent of all people diagnosed with HIV infection will receive ART; and
3. 90 per cent of all people receiving ART will achieve durable viral suppression.

HIV Sensitivity Training Workshop

To improve sensitive communication between healthcare workers and PLHIV, the NCID HIV Programme conducted the HIV Sensitivity Training Workshop on 1 July 2022 to establish a culture of respectful communication and interaction between both parties. The workshop equipped healthcare workers with the necessary skill sets to provide high-quality care to PLHIV and covered topics such as sexuality, gender identity, sex work, drug use, and HIV stigma. NCID HIV Programme plans to conduct this workshop on an annual basis.

Staff putting what they have learnt from the workshop into practice

Asia Pacific HIV Practice Course

The Asia Pacific HIV Practice Course was a collaboration between NUH, SGH, NCID HIV Programme, DSC Clinic, and AfA. It was held from 28 November to 2 December 2022 to improve the expertise of healthcare workers working in the HIV sector throughout the Asia Pacific region. Major topics discussed included local health initiatives for key affected communities, HIV comorbidities and models of HIV care.

13th Singapore AIDS Conference

On 10 December 2022, more than 100 participants gathered at the Lee Kong Chian School of Medicine for the biennial Singapore AIDS Conference (SAC) to learn about the efforts to achieve zero new HIV infections, zero HIV-related deaths and zero discrimination. Themed 'Empowering Communities to End HIV and AIDS', the multisectoral conference recognised the critical roles played by communities of PLHIV, key affected populations and community-based organisations in the fight to end HIV. Discussion points at the SAC focused on Singapore's progress towards UNAIDS 95-95-95 goals for ending HIV/AIDS, building on the momentum and results of previous SACs, and focusing efforts to sharpen and strengthen the response needed to attain Singapore's goals to end HIV. The SAC was co-organised by the NCID HIV Programme in collaboration with AfA and DSC Clinic.

AIDS Candlelight Memorial

On 15 May 2022, NCID commemorated the International AIDS Candlelight Memorial by sharing the stories of two patients on its Facebook page. The stories highlighted

how things have improved with the advancement of HIV management and treatment, particularly with the introduction of government subsidies in September 2020. The subsidies increased accessibility to ART in Singapore, allowing PLHIV to easily assess better treatment which improved their quality of life. Access to better treatment also encourages treatment compliance, allowing individuals to achieve an undetectable viral load which prevents transmission.

World AIDS Day 2022

"Following Jason's Journey" is a four-year World AIDS Day campaign organised by the NCID HIV Programme. In commemoration of World AIDS Day 2022, a webinar was held on 25 November 2022, which focused on the effects of HIV stigma and discrimination during employment. The event also featured a panel discussion – together with Mr Jerry Seah, Senior Director, SNEF – that explored what employers and colleagues could do to build a safer and more inclusive workplace environment for those living with HIV.

The NCID HIV Programme plans to continue the campaign through 2023 and 2024, focusing on relationships and ageing issues for those living with HIV.

NCID HIV Grand Rounds

Since 2018, the NCID HIV Grand Rounds has provided a platform for the healthcare community to discuss the latest in HIV medicine in Singapore, as well as share new research findings, guidelines and policies with each other. In 2022, NCID HIV Programme held three sessions of the HIV Grand Rounds, with close to 400 clinicians, pharmacists, medical social workers, laboratory personnel and community partners attending the event.

During the first session, Dr Rayner Tan, Visiting Research Fellow, NCID and Mr Jan Dewaele, Research Associate (Former), Nanyang Technological University, presented the topic "Effect of Stigma and Discrimination on Health Decisions for People Living with HIV: A Qualitative Study". Additionally, Dr Wilnard Tan, Senior Resident, Infectious Diseases, NCID, shared the clinical features and risk factors for severe or fatal COVID-19 among PLHIV.

Dr Charles Hick, Senior Medical Director, ViiV Healthcare and Adj Asst Prof Wong Chen Seong, Head, NCID HIV Programme, led the second session on 5 October 2022. There, they covered innovative ART technologies to improve health outcomes and quality of life for PLHIV and the intersection of the 2022 mpox outbreak with HIV.

The third session on 23 November 2022 involved Adj Asst Prof Wong and Dr Anchalee Avihingsanon from the Thai Red Cross AIDS Research Centre in Bangkok, with Dr Avihingsanon sharing on the holistic management of HIV/HBV co-infection and Adj Asst Prof Wong focusing on the new aspects of HIV epidemiology in Singapore.

HIV Masterclasses

To educate physicians on key HIV topics related to their specialty, NCID HIV Programme organised two HIV Masterclasses, one for Emergency Medicine and another for Hospitalists, on 18 June and 27 September 2022, respectively. The masterclasses covered topics on HIV-associated conditions in emergency departments, post-exposure prophylaxis, PrEP, common ART drug interactions, non-infectious HIV-related conditions, opportunistic infection and AIDS presentation, and ART and drug-drug interactions. Over 140 physicians attended both sessions.

Healthcare Worker HIV Education Series

The four-part module of the Healthcare Worker HIV Education Series, which took place on 19 March, 28 May, 17 September and 17 December 2022, delved into the stigma and discrimination faced by PLHIV, communications and counselling basics, mental health management, assessment and basic investigations for newly diagnosed cases, management of comorbidities in HIV, and strategies to reduce the risk of HIV transmission. In total, over 700 participants attended the education series. The Healthcare Worker HIV Education Series is co-organised by NCID, NUH and SGH HIV Programmes.

HIV Nursing Education Series

The first module of the NCID HIV Nursing Education Series took place on 25 May 2022 and focused on ART and its proper administration techniques. Organised by the NCID HIV Programme, speakers included Assistant Nurse Clinician K Renganathan, Senior Staff Nurse (SSN) Cheng Ming Jie, and SSN Lam Lan Hua. Over 100 participants attended the series, and feedback from the nurses in attendance was that the knowledge gained would significantly impact their day-to-day nursing of PLHIV.

The team behind the first module of the NCID HIV Nursing Education Series which took place on 25 May 2022

Guest Lectures

Adj Asst Prof Wong and Mr Arun Kumar, Programme Manager, NCID HIV Programme, were involved in two guest lectures over the past year. On 11 April 2022, to a group of Advanced Diploma Nursing students at Nanyang Polytechnic, Adj Asst Prof Wong's lecture described the current trend of infectious diseases, the pathophysiology of infections, the clinical presentation of a patient with infections, and the management of patients with infections. Thereafter, on 24 May 2022, Mr Arun spoke to a group of Singapore Institute of Technology/ University of Glasgow nursing students on HIV and AIDS, transmission and prevention of HIV, the importance of ART adherence, the concept of undetectable equals untransmittable (U=U), and Singapore's public health efforts in achieving the UNAIDS global 90-90-90 targets.

1-to-1 Patient Peer Support Programme

The NCID HIV Programme launched its pilot 1-to-1 patient peer support programme on 1 August 2022 to foster relationships between a PLHIV and a peer supporter to enhance the former's socio-emotional coping skills. Led by Dr Ho Lai Peng, Mr Daniel Chee, Ms Samantha Koh and Ms Isabel Lim from NCID Care and Counselling and Mr Arun, the team aims to expand the initiative by enrolling more patient peer support leaders into the programme.

The pilot 1-to-1 patient peer support programme was launched to enhance the socio-emotional coping skills of a PLHIV

ESG Virtual Wellness Series

The NCID HIV Programme participated in the Enterprise Sports Group's (ESG) Virtual Wellness Series – a free community project started by ESG during the pandemic to empower companies to improve the health literacy and health of their employees and their loved ones – on two separate occasions: "Learn More About HIV" on 30 November 2022, and "Promote Mental Wellness and Inclusivity in the Workplace" on 8 December 2022. Adj Asst Prof Wong gave both presentations. At the former, he debunked common misconceptions about HIV. He shared the importance of medication adherence and viral load suppression. At the same time, his presentation at the latter delved into the types of stigma and discrimination faced by PLHIV, its impact on the individual, and how the public can reduce HIV stigma and discrimination.

Research

Research is vital as it helps healthcare professionals find better ways to prevent, detect, or treat HIV and AIDS. In 2022, the NCID HIV Programme conducted two research studies, which Adj Asst Prof Wong led.

The first study seeks to establish a one-year clinical cohort of young men who have sex with men (YMSM) aged 18 to 29 in Singapore for HIV PrEP delivery and to evaluate the acceptability and feasibility of PrEP and a PrEP teleconsultation service for YMSM. It is the first demonstration study for PrEP in Singapore, which will inform the scale-up of PrEP in Singapore and the implementation of sexually transmitted infections risk counselling in other settings. The second study aims to identify the current status of people in an Asian community living with HIV who have a functional decline in their physical and/or cognitive functioning and any presence of geriatric syndromes or disabilities. The functional decline and quality of life in people ageing with HIV in Asia are largely unknown, and the study aims to shed light on this.

Summary:

1. **The HIVST Pilot Programme was introduced to complement existing testing modalities and allow individuals to test for HIV in the privacy of their own homes.**
2. **Alongside fellow partners, NHIVP co-fronted the National HIV Campaign, tapping on external media platforms to emphasise the importance of knowing one's HIV status.**
3. **Held on 1 June, 5 October, and 23 November, the NCID HIV Grand Rounds provided a platform for close to 400 healthcare professionals to discuss new research findings, guidelines and policies surrounding HIV in Singapore.**
4. **The NCID HIV Programme conducted the inaugural HIV Sensitivity Training Workshop on 1 July 2022 and HIV Masterclasses on 18 June and 27 September 2022 and aims to expand this initiative in 2023.**

Contributed by:

Assoc Prof Sophia Archuleta, Director, NHIVP; Adj Asst Prof Wong Chen Seong, Deputy Director, NHIVP; Dr Choy Chiaw Yee, Consultant, NHIVP; Dr Lee Pei Hua, Associate Consultant, NCID; Ms Lavinia Lin, Senior Executive, NHIVP; Mr P Arun Kumar, Senior Executive, NHIVP; and Ms Sally Low, Senior Executive, NHIVP.

NATIONAL TUBERCULOSIS PROGRAMME

The National Tuberculosis Programme continues towards its vision of a tuberculosis (TB)-free Singapore with people-centred care through prompt diagnosis and treatment of TB cases, effective contact tracing and screening, and community engagement to raise public awareness.

INTRODUCTION

Previously known as the Singapore Tuberculosis Elimination Programme, STEP has been renamed to the National Tuberculosis Programme (NTBP) to signify NCID's consolidation of services under one umbrella of the national programme.

TB remains a global public health threat with an estimated 10.6 million cases of active TB and 1.6 million deaths reported globally in 2021. TB is endemic in Singapore, with a low mortality rate of 0.7 cases per 100,000 population. In 2021, there were 1,306 new cases of active TB among Singapore residents, which translated to an incidence rate of 32.6 cases per 100,000 population.

Despite the restrictions caused by the COVID-19 pandemic, Singapore's TB testing capacity has remained stable, and the NTBP will continue with its commitment of detecting and treating TB by ensuring the continuity of TB-related services for the community.

EVALUATION OF TB PREVENTION AND CARE MEASURES

From 11 to 13 October 2022, a three-day International Review Panel convened at NCID to review Singapore's TB prevention and care measures. The panel's objective was to critically evaluate the measures to identify gaps and areas for improvement, as well as recommend policy improvements that will put NTBP on the right track towards achieving the 20-10-10-20 targets set by the Ministry of Health (MOH).

Alongside Dr Tauhidul Islam (a delegate from the Global TB Programme of the World Health Organization [WHO]), Local Review Panel members, MOH and NCID, the event hosted five renowned experts in the field of TB:

A three-day International Review Panel took place between 11 to 13 October 2022 at NCID to review Singapore's TB prevention and care measures

1. Professor Mario Raviglione (Professor of Global Health, Centre of Multidisciplinary Research in Health Science, University of Milan and Ex-Director, Global TB Programme, WHO)
2. Professor Kenneth Castro (Professor of Global Health, Epidemiology, and Infectious Diseases, Rollins School of Public Health and School of Medicine, Emory University)
3. Dr Paula Fujiwara (Chairperson, Task Force of Global Plan to End TB and Scientific Advisor, Asia Pacific Alliance for Health and Development)
4. Dr Seiya Kato (Director, Research Institute of Tuberculosis, Japan Anti-Tuberculosis Association)
5. Dr Anita Chan Pei-Chun (Deputy Director, Division of Chronic Infectious Diseases, Taiwan Centers for Disease Control)

Following engaging presentations, in-depth evaluations, enriching discussions and insightful sharing sessions, the International Review Panel submitted a formal report of

Public health officers went door-to-door to engage residents at Block 2 Jalan Bukit Merah on the free screening

recommendations to the Permanent Secretary (Health Development) and Director-General of Health for the NTBP to review and adopt the proposed policy changes.

PRECAUTIONARY TUBERCULOSIS SCREENING EXERCISE

In response to the discovery of a cluster of seven cases with active TB disease at Block 2 Jalan Bukit Merah, linked via whole genome sequencing (WGS), NTBP conducted on-site and off-site precautionary TB screening exercises for all residents, workers, and former residents and tenants at the affected block from 27 May to 10 August 2022. NCID – supported by the People's Association – went door-to-door to engage the residents and tenants to encourage uptake of the free screening. The screening involved a blood test (IGRA). In partnership with SATA CommHealth, individuals were screened by mobile teams in their homes, or at a station set up on-site at the Queenstown Hock San Zone Residents' Committee Centre.

Persons screened positive by IGRA were further screened for active TB by an onsite chest X-ray. Consultation was then done in the clinic to advise on treatment. NTBP continues to engage the community to investigate the cluster and maintains close surveillance for any new cases.

EXPANSION OF CONTACT TRACING TEAM

With the goal of reducing TB in Singapore, it became increasingly crucial for NTBP to scale up its contact tracing scope, as contact tracing is key in breaking the transmission of communicable diseases to prevent further spread. With this in mind, the NTBP has begun training new members to expand the contract tracing team.

On a whole, the increase in manpower will aid in the identification of more close contacts of positive TB cases for further testing, as well as expand on-site operations to make screening more accessible for the community. The addition of public health officers who had contact tracing experience during the COVID-19 pandemic will also allow for current work processes to be reviewed from a fresh perspective and reapplied to the contact tracing of TB cases.

OUTREACH EFFORTS

In tandem with NCID's continual public outreach and educational efforts on infectious diseases, NTBP organised several talks to raise public awareness of the health, social and economic consequences of TB. The first talk was held on 12 February 2022 via Facebook Live together with members of the Sembawang West Constituency Office. There, Adjunct Associate Professor Jeffery Cutter, Director, NTBP spoke in greater detail about the effects of TB and addressed questions from the 405 online attendees present.

Thereafter, to commemorate World TB Day on 24 March 2022, a second talk was conducted in collaboration with AWWA. Entitled 'TB is Among Us', the hybrid session hosted participants via Zoom as well as on-site at the AWWA Active Ageing Centre. Through their presentation, Dr Tay Jun Yang, Associate Consultant, NCID and Ms Kelly Foo, Assistant Director, NTBP, talked about the common misconceptions of TB, TB management in Singapore, active TB symptoms and the resulting treatment, and preventive steps on how to safeguard one's health from TB.

Summary:

1. **STEP has been renamed to NTBP to signify NCID's consolidation of services under one national programme.**
2. **NTBP's contact tracing team has been expanded to further aid identification of close contacts of infectious TB cases and expand on-site screening operations.**
3. **To achieve the 20-10-10-20 targets set by MOH, the International Review Panel has submitted a formal report of recommendations for the NTBP to review and adopt.**

Contributed by:
Ms Runni Nadia Mohd Simm, Assistant Manager, NTBP; Dr Tay Jun Yang, Associate Consultant, NCID; and Dr Deborah Ng, Deputy Director, NTBP

COLLABORATIVE PRACTICE

FOR A HEALTHIER SG

STRENGTHENING PARTNERSHIPS THROUGH ONE HEALTH

Disease intelligence work requires understanding complexities and strengthening partnerships at the human-animal-ecosystem interface (One Health). Coming out of the COVID-19 pandemic, the world faces many challenges in health literacy and growing fatigue with misinformation. Finding public health solutions involves professionals of various disciplines coming together in a joint effort.

Assoc Prof Steven Ooi, Senior Consultant and Singapore Field Epidemiology Training Programme Director, International TEPHINET Advisory Board Member

Through collaborative practice, we address the social and environmental determinants of health, and use that knowledge to devise effective strategies for preventing, controlling and reducing health risks. Stakeholders include communities, governments, development partners, international organisations, as well as regional groupings.

URBAN EPIDEMIOLOGY GUIDES RESPONSE

Urban epidemiology partnerships have become an interdisciplinary area focusing on how public health is influenced by the physical environment, economic and social policies, and city lifestyle practices. It provides evidence-based solutions that can reduce health risks and improve well-being in these settings. Field epidemiology training customises its curriculum to an agency's specific domains and instructional goals that constitute competencies for continuing professional development. Case studies on matters such as food hygiene, vector control, environmental sanitation, veterinary practice, or public health policy are set out clearly and stacked to achieve comprehensive and practical proficiencies.

Tiered training allowed individuals to master a specific area through progressive learning, creating more well-rounded trainees and challenging them to keep up to date with the most current information. They thus gained insights and built competencies in how to apply an evidence-based holistic approach to explain transmission dynamics in the emergence of unusual events and outbreaks. Graduating with professional certification by the National University of Singapore, significant milestones would include epidemic intelligence service training, collaboration with the National Parks Board on zoonoses, and community health transformation through whole-of-society activities and a capstone project.

Cities and urban settings are fast becoming

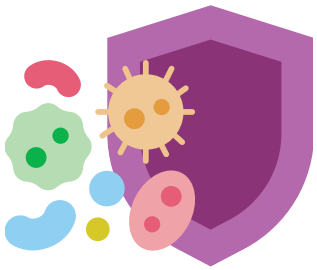
the first line of readiness and response, requiring some sharing of good practices. To date, Singapore Field Epidemiology Training Programme's learning model has benefited over 225 participants comprising field investigators, rapid responders and frontliners from public agencies responding to pandemic situations. Resident trainees and graduate fellows are undertaking many tasks to integrate field epidemiologic methods in managing outbreaks, evaluating the surveillance system, conducting ground studies, and exercising effective communications. The cornerstone of these efforts involves multisectoral collaboration, cultivating partnerships, and building confidence.

AN EXAMPLE OF CULTIVATING PARTNERSHIPS

In humans and animals, antimicrobial resistance (AMR) is exacerbated by: misuse and overuse of antimicrobials; poor access to quality, affordable medicine, vaccines and diagnostics; lack of awareness and knowledge; and global travel. The AMR Quadripartite comprising of the Food and Agriculture Organization, United Nations Environment Programme, World Health Organization (WHO) and World Organisation for Animal Health have recognised that education is the building block to tackling AMR. In 2022, they conducted global consultations to look into ways to develop a common approach to raising awareness on AMR. Awareness resources and tools to reach the 4 Ps (public, policymakers, prescribers, and pharmacists) effectively; the core elements required to support a common approach, common language and common messaging for awareness raising across human, animal, plant and environmental health stakeholders; and opportunities for joint awareness activities and continued collaboration and harmonisation across sectors were discussed.

AMR is a critical global problem, with risks to food and feed production, businesses and trade, interactions with climate change; increased mortality and morbidity in animals and humans; and economic damage, loss of productivity and increased healthcare expenditure. It is crucial that awareness raising about AMR, its drivers, its impact, and its solutions are conducted more collaboratively and collectively across sectors. Furthermore, AMR awareness-raising activities undertaken in one sector can complement awareness-raising objectives in other sectors. Different avenues to reach members of the public must be explored to improve understanding of AMR and appropriate use of antibiotics, such as through antimicrobial stewardship practices and World Antimicrobial Awareness Week activities.

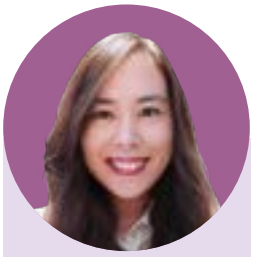
Another area in which to tackle AMR, is the development of a One Health AMR research agenda to guide research in AMR and antimicrobial use across all One Health sectors. In 2022, WHO put out a call to support the development of a One Health Priority Research Agenda on AMR with the strategic objective to catalyse scientific interest and donor investment, and to inform global and national policies to address AMR in a One Health approach. The prioritised research areas included: looking into knowledge gaps to improve the understanding of transmission and impact of AMR across sectors; strengthening the evidence base for effective AMR interventions; policy, economics and finance across sectors; multisector integrated surveillance to inform policy; behavioural insights and change; and cross-cutting issues on gender, vulnerable groups, environment sustainability of interventions, sustainability of AMR measures.



In human health, we recognise the importance of identifying and prioritising research questions on AMR with the objective of determining the burden and determinants of AMR; interventions that are associated with improved AMR prevention, diagnosis, treatment and care and the best ways to deliver these interventions; and catalysing investment and scientific interest amongst academia and industry. In Singapore, the National Strategic Action Plan on AMR has also outlined the need for a national AMR research agenda and the Antimicrobial Resistance Coordinating Office's efforts have focused on coordinating the funding of One Health AMR research studies and the review of the AMR research landscape.

> To date, Singapore Field Epidemiology Training Programme's learning model has benefited over 225 participants comprising field investigators, rapid responders and frontliners from public agencies responding to pandemic situations.

Dr Lee Tau Hong,
Head, Antimicrobial Resistance Coordinating Office



Ms Astrid Khoo,
Assistant Director, Antimicrobial Resistance Coordinating Office

SINGAPORE FIELD EPIDEMIOLOGY TRAINING PROGRAMME

Urban epidemiology is the application of epidemiologic methods to understand and address disease distribution and its determinants in urban settings. The Singapore Field Epidemiology Training Programme (FETP) currently trains a pool of physicians and non-physicians to meet a need for professionals who can carry out the field epidemiologic investigations and disease control.

INTRODUCTION

Singapore's urban epidemiology has guided its risk management approach. Operating out of the National Centre for Infectious Diseases (NCID) and the National University of Singapore (NUS) Saw Swee Hock School of Public Health for fieldwork and classroom didactics, respectively, FETP training is designed to meet the challenging future of public health at all levels of field epidemiology practice. Our training experts have served in the technical advisory group for WHO-FAO-WOAH-UNEP (World Health Organization-Food and Agriculture Organisation of the United Nations-World Organisation for Animal Health-United Nations Environment Programme) which recognises interconnections at the human-animal-ecosystem interface at all levels to achieve optimal health outcomes. Singapore FETP's tiered courses, conducted by experienced trainers, all help to build a sustainable workforce that can meet emerging threats.

TIERED TRAINING IN FIELD EPIDEMIOLOGY

Beginning 2020, Singapore FETP introduced its progressive training model tailoring core curriculum which is based on the US Centers of Disease Control and Prevention's (US CDC) FETP standard curriculum to each public sector agency's needs in the domains and instructional goals that constitute competencies for continuing professional development. Three tiers, representing foundational, intermediate and advanced practice, are applied with agency specific emphases on matters such as food hygiene, vector control, environmental sanitation, veterinary and public health goals being set out clearly. Multiple short courses can be stacked to achieve comprehensive and practical proficiencies in outbreak management, as well as public health policy and practice. The three-tier training system is beneficial because it allows individuals to master a specific area through progressive learning. It helps to create more well-rounded employees by challenging them and keeping them up to date with the most current information and techniques.

Foundational training with groupwork is provided for frontline staff who need grounding in rapid response methods

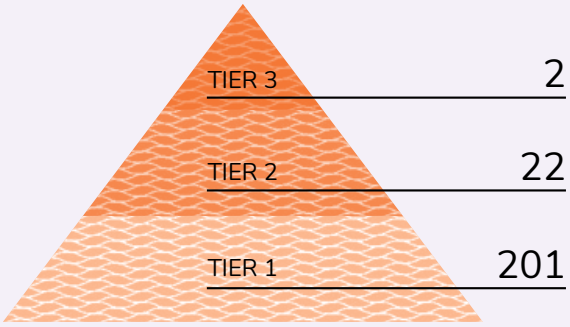
Singapore FETP's progressive model of multisectoral urban epidemiology training has benefited many participants (201 for Tier-1, 22 for Tier-2; and 2 for Tier-3) comprising field investigators, rapid responders and frontliners from public agencies responding to pandemic situations. A sample two-year trajectory of modular coverage with available tiered courses is as follows:

- Basic Outbreak Rapid Response (Foundational Course)
- Field Veterinary and Animal Health Epidemiology
- Elementary Field Epidemiology Methods
- All Hazards Urban Field Epidemiology

FETP trainees learn to integrate field epidemiologic methods into managing outbreaks, evaluating surveillance systems and conducting ground studies

- Infectious Disease and Outbreak Management
- Health Security and Pandemic Response

Significant milestones that were established by Singapore FETP include: 1) professional certification by NUS-NCID for all graduates who satisfactorily complete their practice requirements at each Tier; 2) epidemic intelligence service Master Class training for epidemiologists, infectious disease and preventive medicine residents, and WHO Global Outbreak Alert and Response Network volunteers; and 3) community youth health transformation through an internship called junior FETP for youth as a whole-of-society approach to public health practice in a community tie-up with the Rotary Club of Singapore and the Interact Club of Sembawang.



Number of participants who have benefitted from Singapore FETP's progressive model of multisectoral urban epidemiology training

MULTISECTORAL TRAINING COLLABORATIONS

Multi-Agency Foundational Course

Foundational (Tier-1) training is provided for rapid response teams and frontline staff who need grounding in public health surveillance and outbreak investigations. The annual run of this flagship course took place over five full Saturdays from 9 July to 6 August 2022. There were 31 participants representing the Ministry of Health (MOH), Ministry of Defence, Tan Tock Seng Hospital, NCID, and the National Preventive Medicine Residency Programme. Interaction consisted of 40 hours of didactics interspersed with on-the-job application. The officers acquired basic awareness and understanding of core competencies, with skills to perform field epidemiology objectives under supervision.

Singapore Food Agency

The second run of this customised course saw another 24 food safety inspectors and field investigators from the agency attending a five-day Tier-1 training from 28 October to 11 November 2022. This brings their total number of professionals trained in field epidemiology to 47 staff. The participants learned important lessons from case studies of major foodborne outbreaks of the past and acquired insights into how One Health field epidemiology actually worked. Operating out of NUS Saw Swee Hock School of Public Health for didactics, the training course also included a field visit to NCID, where our Executive Director Prof Leo Yee-Sin and Singapore Food Agency's Deputy CEO (Corporate, Industry, and Technology) Mr Chan Hian Lim discussed some of the challenges faced by public health practitioners in ensuring food security, and the risk management in Singapore's farm-to-fork systems approach.

National Parks Board

National Parks Board (NParks) has entered into its second year of partnership with NCID and NUS for the conduct of its two-segment field epidemiology training programme integrating animal-veterinary services with public health practice. Our second run of this course saw 15 participants, including two seconded veterinarians at SFA, attending segment 1 training (foundational) from 19 April to 24 May 2022, and segment 2 training (field veterinary and animal health epidemiology) from 26 September to 6 October 2022. This brings their total number of professionals trained in field epidemiology to 36. Recognising that zoonoses are naturally transmissible from animals to humans, reducing the risk of zoonotic events requires collaborative surveillance, improved communications, integrated health systems, and a shift toward preventive actions.

Ministry of Social and Family Development

Ministry of Social and Family Development (MSF) partnered with Singapore FETP to arrange for 27 of their officers to participate in Tier-1 training from 15 February to 8 March 2022. Co-facilitated by the Ministry, participants learned to apply epidemiological concepts in outbreak investigations and management. The collaboration arose because of a realisation that infection prevention and control in MSF homes needed proactive strategies with insight into the vulnerability of those at risk, potential outbreak magnitude, and the threat from microbial agents. Training was conducted by epidemiologists from NCID, Changi General Hospital, and MOH.

Ministry of Manpower

In 2022, Singapore FETP worked with Ministry of Manpower (MOM) and the Workplace Safety and Health Council to revise some of the guidance for the healthcare industry in their document, "Workplace Safety and Health Guidelines – Healthcare". We incorporated key principles of outbreak prevention and control that provide guidance to the industry and healthcare institutions when planning, preparing and responding to emergencies. MOM is arranging for their officers to participate in Tier-1 training. Participants will learn to better apply epidemiological concepts in occupational health-related outbreak events. This training to be co-facilitated by the Ministry is being planned for 2023-2024.

Ministry of Education

Starting from an interactive discussion with principals and vice-principals at Ministry of Education's north five school leaders cluster board meeting on 24 March 2022, we were invited again to address teachers and staff on 5 July 2022 at Riverside Secondary School on the impact of COVID-19 on schools and students. At the same time, public health insights had been shared with youth through five monthly hybrid sessions organised by junior college students from January to May 2022. These interactions have set the stage for rollout of a junior field epidemiology training programme involving educational workshops, a disease detective camp, and internship at NCID.

Minister Ong Ye Kung supports junior field epidemiology training for youth to be public health ambassadors in the community

National Preventive Medicine Residency

After the successful 2021 pilot of a specially curated epidemic intelligence training primer for preventive medicine residents, it was rolled out in July 2022 to cover the essential elements of foundational field epidemiology practice. Nine Year 1-2 Preventive Medicine residents took part in the programme in 2022. They were also invited to undertake further professional development and training with experienced professionals at NCID's Epidemic Intelligence Service master classes. The series is designed to prime young doctors for public health problem solving and field epidemiology practice. By learning epidemiologic principles and practice, they can help prevent disease transmission from occurring and manage outbreaks should they occur.

Further Public Health Training

For medical and public health officers who have completed Tier-1 training and seek augmenting competencies, intermediate- to advanced-level training is offered. Pooling graduates from four Tier-1 courses since 2020, an intensive Tier-2 training course on elementary field epidemiology methods was conducted for 22 participants from seven agencies from 28 February to 4 March 2022. They were exposed to a wide range of technical and interpersonal skills needed to lead rapid response on the ground, perform multidisciplinary investigation, and take an evidence-based holistic approach to outbreak management. Advanced trainees go on to Master of Public Health-level modules providing specific knowledge and skills-building at NUS.

INTERNATIONAL HEALTH PARTNERSHIPS

Singapore Cooperation Programme

During the year, Singapore FETP was successful in hosting a five-day workshop on "Urban Pandemic Response in Cities" with NCID, NUS Saw Swee Hock School of Public Health and the Ministry of Foreign Affairs under the Singapore Cooperation Programme from 22-26 August 2022. The workshop covered public health emergencies of international concern, and issues such as policy making, contact tracing and quarantine. A total of 24 international participants from 19 countries across all six WHO regions were able to acquire knowledge and understanding from the Singapore trainers on why urban settings are unique and how to undertake rapid epidemiological response on the ground for disease surveillance, investigation and control.

This course was very well received by the international participants, with a post-course survey score of 4.7 out of 5 overall. An example of the positive feedback was as follows: "It was a great opportunity for the countries from different parts of the world to come together and share the experiences of COVID-19 and to know the challenges and lessons learnt are quite common, although some did so well while some countries had a very difficult time responding. In addition, it was so useful to learn the experience from Singapore on different disease outbreaks, its management and response in an urban setting."

ASEAN+3 Field Epidemiology Training Network

Singapore FETP is a founding member of the ASEAN+3 field epidemiology training network, known as FETN, based in Bangkok, Thailand, and is represented in its Technical Expert Advisory panel. We successfully co-hosted with the US CDC and FETN partners a three-day regional workshop on 'Risk Assessment' on 9, 21, and 26 April 2022.

Singapore FETP Programme Director Assoc Prof Steven Ooi attended the 12th FETN Steering Committee meeting in Brunei Darussalam from 22–24 November 2022. The Steering Committee comprises of representatives from 13 countries, and provides strategic oversight and direction in ensuring the network can deliver on its objectives to:

- Provide support to strengthen FETP capacity at the national level
- Facilitate cooperation and collaboration among members
- Function as a platform for knowledge and experience sharing, training, and regional capacity building

At the meeting, Singapore FETP introduced its progressive model for multisectoral urban epidemiological response training. Milestones included professional certification awarded by NUS to Singapore FETP graduates from over 10 public sector agencies, epidemic intelligence service training at NCID with the collaboration of NParks on zoonoses, and a preventive medicine residency developing the non-communicable disease epidemiology track. An exciting point which interested FETN members and partners was the junior FETP training and internships for youth in a whole-of-society approach to public health practice.

South Asian Field Epidemiology and Technology Network

In 2022, Singapore FETP was co-chair with Indonesia in the South Asian field epidemiology and technology network, known as SAFETYNET, based in Manila, Philippines. At the FETP programme directors meeting in Hanoi, Vietnam, from 5-8 December 2022, a five-year strategic plan was drawn which outlined vision, mission, and values, and the progress on our five priority areas:

- Develop and foster strong partnerships across sectors and institutions in the Asia Pacific region;
- Promote access to high quality public health workforce equipped to meet future challenges in the Asia Pacific;
- Be recognised in the Asia Pacific region as a source of technical capability and excellence;
- Lead innovations that ensure SAFETYNET remains relevant and responsive to changing needs in the Asia Pacific region;
- Develop a representative and sustainable network of unique value to the Asia Pacific region.

In addition, Assoc Prof Ooi serves as invited member on the SAFETYNET scientific committee of the Southeast Asia and Western Pacific bi-regional scientific conference on field epidemiology to be hosted by the Australian National University's FETP next year in Canberra, Australia, from 11-15 September 2023.

International Technical Engagement

There is ongoing technical cooperation in regional projects to promote urban emergency preparedness and response, currently with Brunei, Malaysia, Thailand, Vietnam, Japan, and Australia, as well as with FETN, SAFETYNET and the Training Programs on Epidemiology and Public Health Interventions Network (TEPHINET). One major new development has been the engagement with the US CDC in the area of global health protection and workforce development, involving working with our US counterparts on joint training via virtual and live outreach, materials and curriculum development, professional scientific and programmatic exchanges, capstone projects in Atlanta/Singapore and a non-communicable diseases FETP track.

Assoc Prof Ooi is an elected member on the international TEPHINET Advisory Board and represents the WHO Western Pacific countries. In 2022, he also sat in its Technical Advisory and Scientific Committee. From the many well established network ties, Singapore experts contribute towards global health and are drawn upon by international bodies such as WHO-FAO-WOAH-UNEP and the World Bank to advise in field epidemiology.

Singapore FETP faculty conferring with US CDC counterparts on technical collaboration in global health protection

Summary:

1. **Singapore's urban epidemiology and health emergencies preparedness guided its risk management approach against emergent environmental threats.**
2. **FETP courses are provided for local and international participants in multisectoral risk analysis and outbreak response.**
3. **Epidemic intelligence service training is designed to meet the challenging future of public health.**

Contributed by:
Assoc Prof Steven Ooi, Senior Consultant and Singapore Field Epidemiology Training Programme Director, International TEPHINET Advisory Board Member; and Dr Gao Qi, Senior Epidemiologist, National Public Health and Epidemiology Unit

ANTIMICROBIAL RESISTANCE COORDINATING OFFICE

The National Centre for Infectious Diseases (NCID) leads the nation's multisectoral efforts against antimicrobial resistance (AMR) through the Antimicrobial Resistance Coordinating Office (AMRCO).

INTRODUCTION

AMRCO is a coordinating body to facilitate the implementation of the National Strategic Action Plan (NSAP) on AMR. AMRCO therefore coordinates AMR efforts across different sectors and serves as secretariat for national committees related to AMR. In 2022, AMRCO provided administrative support for the development of a guideline to improve antimicrobial use, continued with surveillance and risk assessment efforts, raised awareness of AMR through education and outreach programmes, and furthered the One Health AMR research agenda.

FORMULATION OF GUIDELINE TO IMPROVE ANTIMICROBIAL USE

As secretariat for National Antimicrobial Stewardship Expert Panel (NASEP), AMRCO provided administrative support for the development of the National Surgical Antibiotic Prophylaxis Guideline (Singapore). The guideline was developed to provide evidence-based recommendations for the rational use of prophylactic antibiotics in adult patients undergoing clean or clean-contaminated surgeries, with the aim of aligning best practices nationally and providing a framework for audit and surveillance.

The guideline was developed through multidisciplinary collaboration of the NASEP National Surgical Antibiotic Prophylaxis Guideline Development Workgroup which comprised of the infectious disease physicians, infectious disease and/or antimicrobial stewardship-trained pharmacists, surgeons, and anaesthesiologists. It was endorsed by NCID and the Chapter of Infectious Disease Physicians, College of Physicians, College of Anaesthesiologists and College of Surgeons under the Academy of Medicine, Singapore.

In addition to the support provided in the development, AMRCO also coordinated the publication and dissemination of the guideline to the relevant stakeholders, and provided funding support for the publication of a manuscript in the *Annals*, Academy of Medicine, Singapore in November 2022.

TRAINING, EDUCATION AND OUTREACH

Education and raising awareness is a core strategy in improving antimicrobial use and reducing the emergence and spread of AMR. To this end, AMRCO has continued to empower its stakeholders with the correct information through engagement and educational activities.

Singapore Antimicrobial Stewardship Training Course

On 18 and 19 August 2022, AMRCO and the Training and Education (T&E) Office under the Infectious Disease Research and Training Office, organised the Singapore Antimicrobial Stewardship Training Course to impart the knowledge and skills needed to establish and operationalise effective antimicrobial stewardship programmes (ASP) in hospitals. Over 40 private and public sector delegates from Singapore and the region attended. Topics covered included funding and governance of hospital ASP, the application of ASP strategies and interventions, and the monitoring of multi-drug resistant organisms and antimicrobial use.

World Antimicrobial Awareness Week

With the aim of increasing awareness and understanding of AMR, AMRCO held activities to reach both healthcare workers and the general public as part of the World Antimicrobial Awareness Week (WAAW) activities, an event that is held from 18 to 24 November every year.

Into its fourth year, the AMR social media campaign was featured on the social media accounts of NCID, National Healthcare Group, Tan Tock Seng Hospital (TTSH), and

Private and public sector delegates from Singapore and the region attended the Singapore Antimicrobial Stewardship Training Course

Health Promotion Board. The social media posts contained information on why AMR is a global public health concern, what the One Health approach to combating AMR is, and the various ways the public can take action.

AMR social media campaign post that was featured on NCID's Facebook page in November 2022

AMRCO also participated in public education efforts which included submitting Q&A articles that were published in *The Straits Times* and *Berita Harian* to address common misconceptions of AMR, as well as a feature article in *Youthopia* to introduce the basics of AMR and its impact to our youths. In addition, Dr Lee Tau Hong, Head, AMRCO was interviewed on the online commentary podcast *The Daily Ketchup*, where he highlighted the consequences of antibiotic misuse and how the public can play their part in reducing antibiotic resistance.

To improve the knowledge of AMR and antimicrobial stewardship practices, AMRCO disseminated collaterals and materials with information on AMR to acute-care hospitals. These resources contained weblinks to medical journals and publications on AMR, and highlighted key actions areas that healthcare professionals could adopt – such as good hygiene habits, proper use of antimicrobials, and patient education – to reduce AMR.

The AMR content on the NCID website was also revamped to include more relevant resources and useful links as a way to further strengthen public education efforts.

WAAW Inter-Hospital Webinar Series

AMRCO and the T&E Office co-organised the WAAW Inter-Hospital Webinar Series, which featured panel discussions and presentations by speakers and panellists from nine public and private hospitals including Changi General Hospital (CGH), Khoo Teck Puat Hospital, KK Women's and Children's Hospital, IHH Healthcare, National University Hospital (NUH), Sengkang General Hospital, Singapore General Hospital, TTSH and Woodlands Health. Held in November 2022, infectious disease experts and ASP-trained pharmacists engaged more than 3,600 participants on topics such as using artificial intelligence in antimicrobial stewardship, the use of antibiotics in COVID-19, management of multi-drug resistant infections, proper antimicrobial prescribing practices and surgical antibiotic prophylaxis.

WAAW Inter-Hospital Webinar Series 2022 cross-institutional panel discussion with NUH, CGH, Ng Teng Fong General Hospital and TTSH representatives

SURVEILLANCE AND RISK ASSESSMENT

AMRCO continued to contribute to global AMR efforts through its participation in World Health Organization's Global Antimicrobial Resistance and Use Surveillance System (GLASS) 2022, which aimed to standardise the collection, sharing and analysis of AMR data. In 2022, Singapore's sentinel surveillance sites increased from three to four through engagement and on-boarding efforts. The aim is to improve the representativeness of the local data.

As secretariat for the National Antimicrobial Resistance Control Committee (NARCC), National Antimicrobial

Resistance Expert Panel (NAREP) and NASEP, AMRCO collects antimicrobial utilisation, stewardship and resistance data from public and private hospitals. This data is then studied and published in annual reports to facilitate subject matter experts' year-on-year monitoring and further analysis of these public and private hospitals' data. Furthermore, AMRCO provides additional support to NARCC's initiatives by drafting technical guidance, providing recommendations for testing standards, and advocating for stewardship in different healthcare settings.

ONE HEALTH REPORT FOR ANTIMICROBIAL UTILISATION AND RESISTANCE

A collaborative effort between AMRCO and government agencies including the Ministry of Health, National Environment Agency, National Parks Board, PUB, the National Water Agency and Singapore Food Agency, the second edition of the One Health Report for Antimicrobial Utilisation and Resistance in Singapore detailed updates on key findings from national surveillance programmes and activities in the human, animal, food and environmental sectors. The report demonstrates the expansion of AMR surveillance programmes since the launch of NSAP. Baseline data up till the end of 2019 is now available for key surveillance populations, which will contribute towards the formulation of science- and risk-based targets to further drive AMR control efforts.

SUPPORTING AMR RESEARCH AS GRANT INTERMEDIARY

Through NCID's capacity as grant intermediary, AMRCO launched the second One Health AMR Research Programme (OHARP) grant call to fund two Transmission Pathways (TP) studies and commission a Socioeconomic Impact (SEI) study. In tandem with the launch, a roadshow was held on 21 February 2022 to share objectives and generate publicity for the event. After the evaluation of submitted proposals by the OHARP Scientific Panel in April, funding was awarded to one TP study and one SEI study on 8 June 2022. The second TP study was awarded funding on 30 June 2022. These studies not only brought together researchers from diverse backgrounds and specialities in the name of understanding AMR in Singapore, they also helped AMRCO foster and deepen partnerships and collaborations with fellow researchers in the AMR field.

REVIEWING SINGAPORE'S AMR RESEARCH LANDSCAPE

A review of AMR research in Singapore, published from 2009 to 2019, was undertaken to understand the current research and innovation to address AMR in Singapore. An increasing trend in AMR research in Singapore was observed since 2009 with many research areas focusing on developing novel therapeutics for treatment, and understanding the current situation of AMR in Singapore through surveillance and epidemiological studies. Some areas of research that were limited included the subjects on AMR transmission, the social and economic impact of AMR, and on the knowledge, attitudes and practices of the population on AMR. Most research articles identified were concentrated in the human sectors and hence there is a need to strengthen our knowledge and evidence base regarding AMR in the animal, environment and food sectors. With the emphasis of a One Health response to address AMR, regular reviews will be conducted by AMRCO to understand how our AMR research landscape is evolving, and to identify priority areas that our research community should focus on to drive Singapore's efforts in combating AMR.

REGIONAL ENGAGEMENT

Regionally, AMRCO is the country coordinator for the Association of Southeast Asian Nations (ASEAN) One Health efforts. Representing Singapore, AMRCO worked closely with Thailand, the Philippines and ASEAN Secretariat, as well as with national agency representatives, in the development of the ASEAN AMR Monitoring and Evaluation Plan and the ASEAN AMR work plan, which are targeted for endorsement in the second half of 2023.

Summary:

1. **During WAAW, AMRCO coordinated a variety of in-person and online activities, and used social media to raise awareness and understanding of AMR among the Singapore population.**
2. **AMRCO and One Health agencies published the second edition of the One Health Report for Antimicrobial Utilisation and Resistance in Singapore to provide key AMR updates on the human, animal, environmental and food sectors.**
3. **Regular reviews of Singapore's AMR research landscape will be conducted to identify priority areas of focus for AMR research.**

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TRAINING AND EDUCATION

FOR A HEALTHIER SG

TRAINING AND EDUCATION TO PROTECT PEOPLE FROM INFECTIOUS DISEASES

NCID protects the people of Singapore from infectious diseases as its mission. Under the Infectious Disease Research and Training Office, the Training and Education (T&E) Office is a core unit of NCID that has embarked on this very important mission through public health advocacy, community engagement, and educational outreach.

Assoc Prof Steven Ooi,
Senior Consultant and Singapore Field Epidemiology Training Programme Drector, Interrnational TEPHINET Advisory Board Member

The COVID-19 pandemic has disrupted all of us with significant impacts on health, mental wellbeing (e.g. frailty, loneliness), livelihoods (e.g. incomes, job repurposing), and hope for the future (e.g. confidence, concern for others). There are lingering concerns with psychosocial health, which is the state of well-being where every individual realises his or her own potential, can cope with normal stresses of life, can work productively and fruitfully, and is able to make a contribution to his or her own community. As we strive for a Healthier SG, the whole-of-society public health approach can be an important mover for improvements.

In June 2022, we hosted the first Disease Detective Camp as a community outreach to 16-19 year olds drawn from secondary school and junior college students. This unique experience provided the youth with observations of social capital in a transactional society and showed how community-based responses are a vital asset that must be cultivated in an environment of trust, relations and communication. The camp promotes mental and physical wellness as well as community wellbeing to build up resilience in the youth who graduate from the camp as young Public Health Ambassadors.

In October 2022, we worked with the Ministry of Education and schools, polytechnics and junior colleges to conduct a one-day Outbreak Scene Investigation Workshop on applied epidemiology and public health. The aim is to support and sustain the health and wellbeing of the youths of Singapore, and also get students to understand what are the future career opportunities available for them to take up in

public health, medicine and the biomedical sciences. Various agencies worked together to provide this workshop.

In addition, we have developed and rolled out an internship programme for Youth Leaders in 2022. Linked to the junior field epidemiology training programme, suitable candidates among the youth who are holding leadership positions in community-based public health activities may apply for an internship in infectious disease intelligence at NCID to understand better the relationships between public health practice, field epidemiology, and the community.

This whole-of-society approach requires us to work with young Public Health Ambassadors, the Rotary Club of Singapore, and other partners to initiate activities for community health transformation as youth advocates who are empowered with training, can also possibly go on to pursue meaningful vocations in public health and healthcare. Throughout the year, further activities in this public health-caused based community movement are implemented through the Interact Club of Sembawang and the Rotaract Club of Singapore City. These collaborations lead to long-term working relationships that will empower our youths and members with public health knowledge in helping our communities weather future pandemics.

With the COVID-19 pandemic raising the profile and interest in matters related to infectious diseases among the members of the public, it is of equal importance that healthcare professionals remain well equipped with knowledge pertaining to infectious diseases. Lessons learnt and insights gained from the pandemic have been incorporated in our training strategies and educational efforts.

We continued our efforts in reaching out to the intermediate and long term care sector and regional health systems to ensure the continued development of capabilities in the various areas relevant to infectious diseases and are on the lookout for opportunities to collaborate with other sectors to further enhance the delivery of training and educational activities.

The key to effective training and education is in the activities that cross and involve several sectors such as national development, environment, health, education, trade, and industry. It is often used in the context of public health initiatives and involves collaboration among different government departments and other stakeholders from a variety of sectors, such as civil society organisations, the private sector, and community groups. By working together through outreach and publications, these parties can create healthier and more sustainable solutions to public health challenges.

In our whole-of-society approach, infectious disease training and education provides knowledge on how to prevent, control, and mitigate the spread of infections. It includes topics such as personal protective measures, infection prevention and control, use of disinfecting agents and cleaning. It may also provide guidance on how to respond to public health emergencies and develop personal plans for contingency management. Additionally, advisories on implementing business continuity in the workplace and other areas can be furnished.

For professionals, knowledge in the specific area of One Health epidemiology is important because it focuses on how to detect, contain, and mitigate the spread of all kinds of outbreaks, including zoonoses, and how epidemic intelligence services strengthen emergency preparedness, community health protection and public health leadership. Guidance is provided on responding to health emergencies with personal protective equipment, infection control and prevention, proper use of disinfecting agents and cleaning, case management, coordinating with other agencies, and implementing public health strategies.

Dr Tan Seow Yen,
Head,
Training and Education Office, Infectious Disease Research and Training Office

COMMUNITY ENGAGEMENT AND OUTREACH

The National Centre for Infectious Diseases (NCID) organises a variety of engagement efforts and publishes an educational bulletin to educate, inform and promote a greater understanding of infectious diseases in the community.

INTRODUCTION

A unit under the Infectious Disease Research and Training Office (IDRTO), the Training and Education (T&E) Office supports community efforts by focusing on public education, and community partnerships and engagement to build community preparedness for outbreaks and prevent the spread of infectious diseases in Singapore. Besides community engagement efforts, NCID publishes a regular bulletin on thematic infectious disease issues for the medical and public health community, as well as the general public.

EDUCATION OUTREACH FOR YOUTH

Understanding that the youths of today can be effective changemakers in the community when given the appropriate tools, the T&E Office has continued its youth outreach efforts to equip them with the necessary skills and knowledge on infectious diseases.

Young Public Health Ambassador Series and Inaugural Disease Detective Camp

Student participants visited the National Public Health Laboratory as part of the Disease Detective Camp

Working with the National University of Singapore (NUS) Saw Swee Hock School of Public Health, NCID has created opportunities for youth to become inspired by disease detective work as junior field epidemiologists and to explore interesting careers in public health, medicine and the biomedical sciences. Through a young Public Health Ambassador series held over five Saturday afternoons from January to May 2022, 57 students from secondary schools and junior colleges across the island were introduced to basic epidemiology and the world of disease detectives.

As part of the inaugural Disease Detective Camp, 35 student participants visited NCID to further their understanding of infectious diseases and the impact it has on Singapore

An inaugural Disease Detective Camp was organised by NCID and the Rotary Club of Singapore at Admiralty Medical Centre from 13 to 15 June 2022. Over the three days, 35 student participants were guided by Interact Club advisors, public health experts from NUS and NCID and community health practitioners from Yishun Health on how to plan and implement initiatives for community health transformation in the Sembawang area.

To further their understanding of infectious diseases and the impact it has on Singapore, the participants visited NCID to observe the work done at the National Public Health Laboratory, tried donning and doffing of personal protective equipment, visited The NCID Gallery, attended a talk by Prof

Leo Yee-Sin, NCID Executive Director, and chatted with NCID staff on potential careers in healthcare.

In partnership with the Rotary Club of Singapore and the Interact Club of Sembawang – the first public health-cause based community club in Singapore – the freshly minted young Public Health Ambassadors were introduced to applied epidemiology in disease prevention and health promotion, classes on environmental, metabolic, mental and food health, as well as various community outreach efforts on making informed choices and lifestyle changes throughout 2022. These ambassadors acquired not just knowledge, but also attitudes, lifestyle behaviours and engagement skills that would be helpful with their parents, families, friends and social circles.

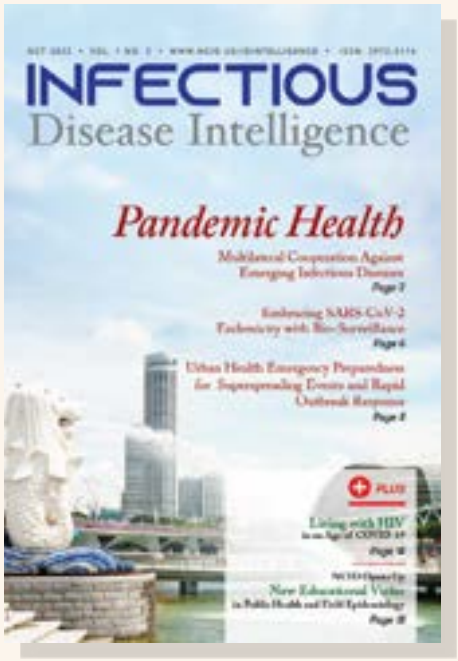
Outbreak Scene Investigation Workshop

More partnerships were sealed in the second half of the year when NCID tied up with Republic Polytechnic and Ministry of Education (MOE) involving a junior college and several secondary schools to conduct a full day workshop on Outbreak Scene Investigation on 26 October 2022. The 156 secondary school and junior college students in attendance learned more about professional careers and the whole-of-society approach that is needed to uphold public health. Such learning opportunities and partnerships have benefitted all parties as well as the community at large. NCID looks forward to providing more opportunities for internships, workshops and symposia with good education partners, grassroots organisations, and MOE.

INFECTIOUS DISEASE INTELLIGENCE

In February 2022, NCID launched *Infectious Disease Intelligence*, an educational publication for the infectious diseases and public health community that is published twice a year. The theme of the first issue was "Tuberculosis" and was intended for a readership comprising general audiences, students, undergraduates, physicians, epidemiologists, microbiologists, laboratorians, researchers, scientists and public health practitioners. Besides promoting community awareness, the launch of this publication opens up new vistas in public health training and education. A downloadable copy of each publication is provided free of charge at www.ncid.sg/IDintelligence.

The second issue was published in October 2022 on the theme of "Pandemic Health." With concerns for international movement and spread, this issue served as a timely reminder that we live in a rapidly developing world where national boundaries are becoming more porous due to the rise in trade and travel. Being a global hub, Singapore cannot be spared from emerging infectious diseases. Vigilance is needed as we remain receptive to the introduction of exotic infections because of the presence of tropical vectors, and vulnerable due to our position as a key transportation node.



Our second issue

Positive feedback has been received on the publication of *Infectious Disease Intelligence.* As infectious disease is one area where community partnerships are proven useful to safeguard public health, the aim is to morph *Infectious Disease Intelligence* into a regular bulletin for students and professionals, and serve as a trusted information source for the general public. Coverage will include all activities related to early identification of infectious health threats, their verification, assessment and investigation in order to recommend appropriate measures to control them. With many public health concerns making the news headlines lately, NCID is working doubly hard to safeguard health and wellbeing in our community.

Summary:

1. **A young Public Health Ambassador series was organised from January to May 2022 to introduce students to basic epidemiology and the world of disease detectives.**
2. **Outreach programmes for youths such as the Disease Detective Camp and Outbreak Scene Investigation Workshop have contributed to their better understanding of infectious diseases and its impact on society.**
3. **Published twice a year, *Infectious Disease Intelligence* is an educational publication that serves as a trusted information source for the general public to promote community awareness on infectious diseases.**

Contributed by:
Assoc Prof Steven Ooi, Senior Consultant and Singapore Field Epidemiology Training Programme Director, International TEPHINET Advisory Board Member; Dr Tan Seow Yen, Head, T&E Office, IDRTO; and Mr Lwa Ju Peng, Assistant Director, T&E Office, IDRTO

ENGAGEMENT AND OUTREACH TO HEALTHCARE AND OTHER PROFESSIONALS

To enhance the overall preparedness and resilience of Singapore's healthcare system in the face of infectious disease outbreaks, the National Centre for Infectious Diseases (NCID) is empowering healthcare and other professionals with the knowledge and tools to effectively prevent and manage such threats through various training programmes, conferences and collaborative research projects.

INTRODUCTION

NCID provides expertise in infection control to external agencies and organisations through the engagement and training efforts of its Infection Prevention and Control (IPC) team. Concurrently, the Nursing team, Training and Education (T&E) Office and NCID's field epidemiology faculty collaborate with the healthcare sector and other industry partners to share knowledge on management of infectious diseases. For example, we worked with the National University of Singapore Centre for Biomedical Ethics on two case studies involving public health ethics which were presented on 29 September and 6 October 2022 to promote ethical considerations in disease control.

To promote Singapore as a centre of excellence, we developed international training courses for senior administrators and public health professionals. We also provided technical expert advisories at the 3-day ASEAN+3 FETN workshop on Risk Assessment (on 19, 21, and 26 April 2022), and at the 7th Asia Pacific Conference on Public Health (from 2 to 4 August 2022). In addition, under the framework of the Singapore Cooperation Programme, we delivered the first international course, "Urban Pandemic Response in Cities" to 24 participants from 19 countries (from 22 to 26 August 2022).

INFECTION PREVENTION AND CONTROL

NCID's IPC team continued its engagement and worked closely with partners on disseminating information and imparting skills on IPC best practices to improve ground processes and preparedness in the fight against infectious diseases.

IPC Workshop for Ministry of Social and Family Development

During the COVID-19 pandemic, welfare homes under the Ministry of Social and Family Development were required to institute IPC measures. As there was a lack in knowledge on IPC, it was important to look into training. The NCID IPC team conducted a number of 'Fundamentals of IPC' workshops for the staff to build core IPC knowledge and impart skills to improve occupational safety when delivering care services in welfare homes.

The two-day workshop took a "learning-by-doing" approach and comprised interactive discussions, practical demonstrations and group activities, with the curriculum designed to cater specifically to the needs of the welfare homes. IPC pillars such as standard and transmission-based precautions, environmental and food hygiene, linen and waste management, common infectious diseases, governance and policy, immunisation and outbreak management were covered at the workshop. To ensure that participants were provided with sufficient guidance, a team of senior nurses from NCID also assisted with the content delivery as group facilitators.

ONE HEALTH EPIDEMIOLOGY

In an age of pandemics, healthcare and other professionals have to investigate into unusual events, analyse emergent threats and their risk factors and develop strategies including public health advocacy to control infectious spread. They also study disease conditions among populations, outbreak patterns and causes and effects of ecosystem changes. All of these involve One Health epidemiology and the use of

an all-hazards approach to risk assessment and mitigation, dealing with incidence, distribution and control of emerging infectious diseases.

On 7 April 2022, NCID's field epidemiology faculty co-hosted a webinar with the National Environment Agency (NEA) on dengue in Singapore for 28 participants. During the session, colleagues from NEA's Environmental Health Institute shared on the national dengue control framework and Project Wolbachia. Participants were also taken on a virtual tour of the Wolbachia mosquito production facility.

On 21 July 2022, amid rising concerns with the rapidly growing global mpox outbreak, NCID's field epidemiology faculty conducted a multisectoral table-top exercise to assess the risks to Singapore. Participants included senior epidemiologists, operations staff, preventive medicine residents and experts from various agencies such as the Ministry of Health (MOH), National Parks Board and Tan Tock Seng Hospital. By sharing inputs related to outbreak management and control in three different scenarios, participants had the opportunity to learn more about the whole-of-government capabilities for rapid response to emergent public health events.

On 17 November 2022, NCID's field epidemiology faculty interacted with the NEA rodent-control team at NEA Central Regional Office and on-site at the ABC Hawker Centre to exchange knowledge and share experiences on the epidemiology, surveillance and control of rodent-borne diseases such as leptospirosis, typhus and hantavirus infection. A field visit was also arranged for that evening at the Pek Kio Market and Food Centre, where eight participants observed NEA's night inspection works and learned more about modern rat surveillance technologies deployed at our markets and hawker centres. These interactive sessions gave the participants an appreciation for strong partnerships in the fight against rodent-borne diseases in Singapore.

ENGAGING THE LONG-TERM CARE SECTOR

Prior to the COVID-19 pandemic, NCID and the Agency for Integrated Care (AIC) began a multi-year collaborative which sought to improve the IPC standards of the long-term care facilities under AIC such as nursing homes and day care centres. The collaborative would entail a structured programme with activities that would enable the participating nursing homes to improve or resolve their identified IPC gaps and share their experiences with other nursing homes.

After a pilot run in 2020, which had a reduced programme due to COVID-19 outbreak, NCID and AIC embarked on the implementation of the full programme for nursing homes in 2022. NCID worked with AIC to set up the standards and checklists for the nursing homes to reference.

As part of the NCID and AIC multi-year collaborative to improve the IPC standards of long-term care facilities, participating nursing homes attended a workshop on clinical theory and application

In September 2022, a workshop on clinical theory and application was successfully completed to provide the knowledge and reinforce the understanding of IPC principles to the participating nursing home staff. These included a deep dive into the National IPC Guidelines for long-term care facilities, setting up of an IPC Committee, IPC precautions, care of medical devices and surveillance and outbreak management. As part of a national effort, NCID engaged subject-matter experts from various public healthcare organisations to speak at the workshop.

Following the workshop, the participating nursing homes identified the gaps in their IPC programme for improvement. Changi General Hospital and AIC provided in-person feedback and advice on their initiatives in order to improve their IPC practices in this run of the collaborative.

TRAINING FOR FRONTLINERS

From January to September 2022, the NCID Outbreak Nursing team conducted 16 training sessions on infection control, workplace safety, personal protective equipment donning and doffing techniques and N95 mask-fitting for the MOH Public Health Group. The training sessions were attended by more than 150 participants from the field surveillance, quarantine, border health and home recovery sectors. The training sessions were designed to strengthen preparedness against infectious disease outbreaks.

COVID-19 CLINICAL UPDATES

To keep the healthcare community at large informed of the COVID-19 epidemiology trend as well as provide updates on clinical management and advances in therapeutics, the T&E Office organised two webinars which were attended by over 1,600 healthcare professionals.

NCID experts providing updates at a webinar on COVID-19

Professional Webinar: Clinical Update on COVID-19 (Omicron Variant and Oral Therapeutics)

Especially relevant for those caring for COVID-19 patients in various clinical settings, this webinar held on 19 February 2022 highlighted the clinical characteristics of the disease caused by the Omicron variant and provided an overview of the oral antivirals used for treatment. The speakers were Adj Assoc Prof Matthias Paul Toh, Director, National Public Health and Epidemiology Unit and Senior Consultant, Adj Asst Prof Shawn Vasoo, Clinical Director, Head, Infectious Disease Research Laboratory and Senior Consultant, and Ms Varsha Ramakrishnan, Senior Pharmacist, NCID Pharmacy.

Professional Webinar: Clinical Update on COVID-19

This webinar held on 10 June 2022 provided healthcare professionals with an update on the latest COVID-19 developments and insights on how healthcare professionals can continue to keep their patients protected against severe disease. Speakers Assoc Prof Barnaby Edward Young, Head, Singapore Infectious Disease Clinical Research Network and Senior Consultant, Prof David Lye, Director, Infectious Disease Research and Training Office and Senior Consultant, and Adj Asst Prof Vasoo covered topics on epidemiology, disease severity, impact of vaccination and the variants of concern (BA1/2/4/5), as well as updates on therapeutics and local COVID-19 management protocols.

KNOWLEDGE SHARING WITH THE HEALTHCARE COMMUNITY

The Continuing Professional Education Symposium hosted by the Infection Control Association (Singapore) was held on 19 February 2022. The symposium discussed experiences gained and lessons learnt from managing COVID-19 outbreaks at various healthcare settings.

Assistant Nurse Clinician Paige Phoon Long Yoke from the NCID Outbreak Nursing team shared about investigating outbreaks in a healthcare setting with the triangulation of information gathered from epidemiological data, whole genome sequencing and staff interviews. Effective prevention strategies based on critical conclusions drawn from the investigation, as well as future implications to prevent emergence and onward transmission of nosocomial infection among healthcare workers, were also highlighted.

Additionally, the NCID IPC team launched the IPC Journal Club in 2022, which was a new initiative comprising topical review and research presentation for those interested in IPC from Singapore and the region. The session is extended to participation from community partners. By 24 May 2023, 10 sessions have been held and more than 1,000 local and overseas participants attended the sessions.

Summary:

1. **NCID continued working closely with partners to share information and impart skills on IPC best practices to increase preparedness in the fight against infectious diseases.**
2. **A multi-year collaborative effort between NCID and AIC would help long-term care facilities such as nursing homes and day care centres improve and resolve identified IPC gaps.**
3. **Webinars providing clinical updates on COVID-19 were held to keep the healthcare community informed on new variants, changes to clinical management and advancements in therapeutics.**

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RESEARCH

FOR A HEALTHIER SG

INFECTIOUS DISEASE RESEARCH AND TRAINING OFFICE

The Infectious Disease Research and Training Office (IDRTO) conducts and supports research as part of the national preparedness and defence against the threat of emerging infections, in line with the National Centre for Infectious Diseases' (NCID) role in protecting the people of Singapore from infectious diseases.

INTRODUCTION

Research, training and education are vital components in the defence against the threat of emerging infections. Aligned with NCID's mission, IDRTO is a unit within NCID to fulfil its unique role as a national asset with domain expertise in public health, academic research and clinical excellence, as well as outbreak preparedness for both healthcare workers and the general public.

IDRTO comprises:

1. National Infectious Disease Research Coordinating Office
2. NCID Research Office
3. Training and Education Office
4. Singapore Infectious Disease Clinical Research Network
5. Pandemic Preparedness and Research Coordinating Office
6. NCID Research Clinic
7. Infectious Disease Research Laboratory

NCID'S RESEARCH ACHIEVEMENTS

In 2022,

Awarded more than S$7 million of research grants

Published more than 120 publications

Initiated 26 research studies with 120 ongoing research studies

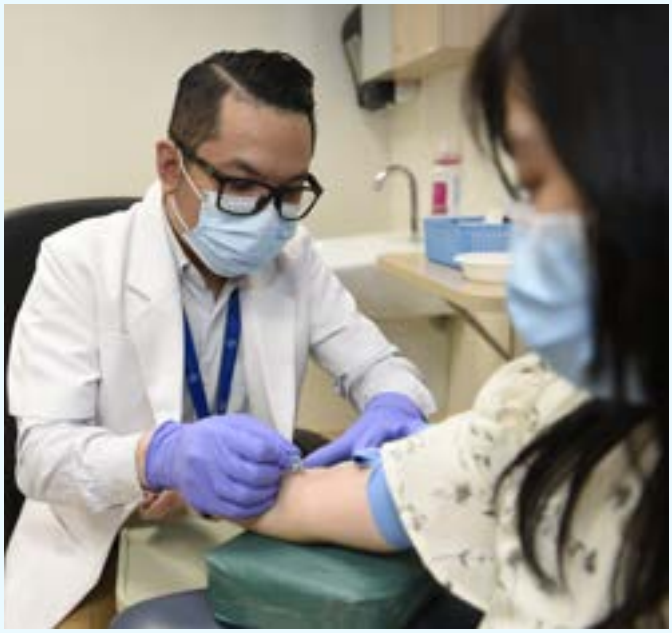
Supporting Research through Catalyst Grants and Short-Term Fellowships

Funded by the Ministry of Health (MOH) and administered by NCID, the NCID Catalyst Grant encourages collaborative research projects and exchanges in the fields of infectious diseases, and public health research between clinicians and scientists, and hospitals and/or research centres and/or academic institutions. The Catalyst Grant focuses on Health and Biomedical Sciences infectious disease priority areas such as antimicrobial resistance, vector-borne diseases, respiratory tract infections (including COVID-19 and tuberculosis), and HIV. As the secretariat of the NCID Catalyst Grant, the National Infectious Disease Research Coordinating Office (NIDRCO) administers the Catalyst Grant call nationwide targeting public health institutions, national specialty centres, universities, and academic medical centres. In 2022, eight projects were awarded, of which three were from NCID.

NIDRCO is also the secretariat that administers the NCID Short-Term Fellowships which aims to encourage networking and research collaborations between healthcare and research institutions in Singapore and overseas, equip infectious disease researchers with skills and experience relevant to their area of research, and provide promising young researchers with exposure to the diversity of infectious diseases in Asia and Australasia. In 2022, eight NCID Short-Term Fellowships were awarded of which one was from NCID.

Supporting Research through NCID Research Clinic

The NCID Research Clinic supports investigator-initiated and industry sponsored studies from NCID, other institutions within National Healthcare Group (NHG), and the wider infectious disease community in Singapore. The NCID Research Clinic is the site for long-term follow-up of COVID-19 research subjects recruited under PROTECT, a multicentred prospective study to detect novel pathogens and characterise emerging infections. In 2022, a total of 6,000 recruited patients visited the NCID Research Clinic for first and subsequent follow-up visits, and there are currently 17 ongoing research studies being conducted.



A Research Staff taking blood samples from a study subject

National COVID-19 Research Workgroup

Established in January 2020, the National COVID-19 Research Workgroup (RWG) has been instrumental in contributing to the knowledge of COVID-19 transmission, pathogenesis, detection, therapeutics and social-behavioural impact locally and globally.

The RWG is chaired by Prof Leo Yee-Sin, Executive Director, NCID under the guidance of Chief Health Scientist Prof Tan Chorh Chuan with key representatives from NCID, MOH, National Medical Research Council (NMRC), NHG, National Public Health Laboratory (NPHL), Duke-NUS Medical School, Agency for Science, Technology and Research (A*STAR), National University of Singapore (NUS), National University Hospital (NUH) and Nanyang Technological University (NTU), DSO National Laboratories and Consortium for Clinical Research and Innovation, Singapore. The Workgroup met fortnightly from January 2020 till June 2022 and subsequently monthly till November 2022. As of 31 December 2022, more than 70 discussions have been held.

From 2023 onwards, the RWG transitioned to Programme for Research in Epidemic Preparedness and REsponse (PREPARE) RWG, held on a monthly basis and chaired by PREPARE's Executive Director Prof Wang Linfa. PREPARE RWG seeks to sustain and strengthen the infectious disease/emerging infectious disease research network in Singapore by bringing key research stakeholders together, across institutions and disciplines, to enable a coordinated and synergistic research response in the face of an epidemic.

NCID Scientific Research Advisory Board Meeting

Held virtually from 28 to 30 September 2022, more than 50 representatives from MOH, research institutes, public healthcare clusters, medical schools and academic institutes attended the first NCID Scientific Research Advisory Board (SRAB). The meeting aimed to:

- Provide guidance and strategic advice on infectious disease research direction in Singapore
- Identify gaps, strengths and weaknesses, and propose areas for growth and strategies to meet the needs in Singapore and achieve regional and international excellence in infectious disease research relevant to Singapore, including assisting the expansion of Singapore's international research network
- Advise on research outcome assessment

NIDRCO is the secretariat of NCID SRAB. Following the meeting, NCID SRAB members provided a post meeting report with detailed observations and recommendations in an effort to strategically plan infectious disease research post-COVID-19.

On-site Evaluations of Antigen Rapid Tests and Point-of-Care Test Assays for COVID-19

Since 2020, NCID has been collaborating with the MOH Technology Evaluation and Implementation Unit on on-site evaluations of Antigen Rapid Tests (ARTs) and Point-of-Care Test Assays used in the testing for COVID-19.

The research objectives of these studies are to conduct diagnostic clinical validations against product claims, advise policy decisions on public health and determine patients' ability and attitudes towards self-testing for selected products with such claims.

Till date, the Infectious Disease Research Laboratory (IDRL) has carried out diagnostic validations on nasal ARTs, oral ARTs, nasal and oral combination ARTs, Loop-mediated Isothermal Amplification (LAMP) tests, Variant of Concern, lolli-method, and breathalyser tests. Some evaluations have concluded, while others are still ongoing with a target for completion in April 2024.

The newly set-up BSL2+ suite

Setup and Gazetting of IDRL BSL2+ Suite

To enable IDRL to store and conduct research on Risk Group 3 (RG3) patient samples, a BSL2+ suite was set up in June 2022. The implementation required equipping a single suite in the IDRL virology laboratory with appropriate laboratory equipment, a security and air pressure monitoring system, the development of new sample handling, storage and disposal protocols, and a subsequent review and approval by MOH.

Having supported various COVID-19 related clinical studies, this initiative, when gazetted, will allow IDRL to expand into other RG3 pathogen related studies, with the necessary approvals. Thus far, over 20 clinical samples such as Universal Transport Medium and blood have been processed in the BSL2+ Suite.

The development of the IDRL BSL2+ suite was led by IDRL Principal Scientific Officer Dr Conrad Chan, Laboratory Manager Ms Siti Nurdiana Binte Abas, and Biosafety Officer Dr Yogeswari D/O Chandran.

INVEST Trial

The incidence of gram-negative bacteraemia is rising globally, and remains a major cause of morbidity and mortality for hospitalised patients. Although practice guidelines provide general recommendations for treatment duration for gram-negative bacteraemia, the optimal route of administration is yet to be definitively defined. The majority of patients with gram-negative bacteraemia initially receive intravenous (IV) antibiotic therapy. However, it remains unclear whether patients can step down to oral antibiotics after appropriate clinical response has been observed without compromising outcomes.

Led by IDRTO Director Prof David Lye, the multi-institutional INVEST trial, also known as the Early Oral Step-Down Antibiotic Therapy Versus Continuing Intravenous Therapy for Uncomplicated Gram-Negative Bacteraemia trial, aims to evaluate the clinical efficacy and economic impact of early step-down to oral antibiotics (within 72 hours from index blood culture collection) versus continuing standard of care IV therapy (for at least another 48 hours post-randomisation) for clinically stable/non-critically ill inpatients with uncomplicated gram-negative bacteraemia. NCID is the coordinating centre for this international trial.

The project is funded by NMRC Clinical Trial Grant and NHG Community Fund. Trial recruitment started in April 2022 and recruitment is still ongoing.

PRIBIVAC Clinical Trial

Assoc Prof Barnaby Young, Head, Singapore Infectious Disease Clinical Research Network (SCRN) led the PRIBIVAC clinical trial, also known as the Efficacy of Different COVID-19 Vaccine Combinations in Inducing Long-term Humoral Immunity trial, where varying participant groups were given different vaccine combinations and observed for 28 days.

This clinical trial helps build local data on understanding immunity towards COVID-19 through booster shots. PRIBIVAC aims to:

1. Obtain local data on vaccine response after homologous or heterologous mRNA booster shots, and examine how the immune response from these booster shots changes over the months after vaccination;

2. Study non-mRNA vaccines (such as Covaxin) and determine if the antibody levels after the booster shot with these vaccines are similar to mRNA vaccines;
3. Compare the immune response between homologous and heterologous booster shots and test the hypothesis that giving a heterologous booster might improve vaccine responses against variants as compared to the wildtype vaccine strain of SARS-CoV-2.

This clinical trial has enrolled 308 participants as of 31 March 2023. Phase A of the study enrolled 100 participants, of which 51 participants were allocated to control arm (homologous mRNA booster) and 49 to intervention group 1 (heterologous mRNA booster). Phase B of the study enrolled 50 participants, of which 24 participants were allocated to intervention group 2 receiving Covaxin while the other 26 participants were randomised to receive Pfizer or Moderna vaccines. All participants in Phase A have completed day 28 visits and day 180 visits were scheduled from April to June 2022. Participants in Phase B completed their day 28 visit by the end of April 2022. Phase D of the study is ongoing with 158 participants enrolled as of 31 March 2023.

The clinical trial is supported by A*STAR, Duke-NUS Medical School, the Singapore Clinical Research Institute and KK Women's and Children's Hospital.

STRENGTHENING PARTNERSHIPS THROUGH ENGAGEMENTS

IDRTO continued to expand its understanding on infectious diseases through in-person and virtual knowledge exchange with fellow industry experts.

NCID-Japan's National Institute of Infectious Diseases Symposium

On 31 October 2022, a joint virtual symposium between NCID and Japan's National Institute of Infectious Diseases (NIID) was held. The symposium aimed to foster deeper collaborative research ties between the two institutions and serve as a platform to explore mutual areas of interest in COVID-19 and beyond, with the end goal of establishing potential future research collaborations.

Topics covered at the symposium included:

- 'Immune monitoring and real world effectiveness of COVID-19 vaccination in Singapore' by Prof Lye
- 'Immune profiling of COVID-19 Vaccine' by Dr Yoshimasa Takahashi, Director, Research Center for Drug and Vaccine Development, NIID
- 'The Immunological Response to SARS-CoV-2 Infection and Viral Kinetics of its Variants of Concern' by Assoc Prof Young
- 'Virological and Serological Characterisation of SARS-CoV-2 Omicron Infections' by Dr Tadaki Suzuki, Director, Department of Pathology, NIID

More than 70 participants, including staff from both organisations and participants from Japan's National Center for Global Health and Medicine attended the symposium.

NCID-Imperial College London Symposium

On 9 December 2022, over 50 healthcare practitioners from NCID and Imperial College London (ICL) participated in the joint virtual symposium which aimed to explore areas of research priorities, complementary strengths, and avenues to further strengthen collaborative partnerships.

SCRN team in a discussion on studies conducted

Launch of MoU with ICL

At the symposium, a Memorandum of Understanding (MoU) was jointly launched by Prof Leo and Prof Charles Bangham, Co-Director of the Institute of Infection, ICL. The MoU, signed earlier on 30 November 2022, formalised the mutual commitment to a deeper partnership in research, education and training. Special guests in attendance to witness the launch of the MoU included Prof Kenneth Mak, Director-General of Health, MOH, senior leaders from ICL, and staff from Infectious Diseases Department in Tan Tock Seng Hospital as well as staff from NCID.

NCID and ICL will identify priority areas for future collaboration – such as mathematical modelling, epidemiology and human infections challenge – for future collaboration. One such example is NCID's Assoc Prof Young and ICL's Prof Chris Chiu, an infectious disease physician and immunologist who are working together with the aim of advancing development of the next generation of vaccines and treatments.

Bacteriophage Workshop

On 30 May 2022, a bacteriophage workshop was conducted to bring together researchers and clinicians from various institutions to share their current bacteriophage research in Singapore. The objective of the workshop was to curate current research efforts in Singapore, define a comprehensive plan for the bacteriophage research in Singapore and eventually lead to a grant application across different institutions, as well as to define gaps in bacteriophage research in Singapore for international collaboration.

The workshop included sharing on the research of phage discovery and selection, establishing phage library, phage engineering, phage therapy, and studies of vivo models. The speakers included Assoc Prof Pablo Bifani, Assoc Prof at the Department of Microbiology & Immunology, NUS; Prof Laurent Renia, Programme Director of Respiratory and Infectious Diseases and Professor in Infectious Diseases, Lee Kong Chian School of Medicine, NTU; Dr Jasmine Chung, Senior Consultant, Department of Infectious Diseases, SGH; and Ms Nurhidayah Binte Mohamed Yazid, Research Assistant, IDRL, NCID.

NCID Monthly Research Meeting

Together with co-hosts from SingHealth, National University Health System (NUHS), A*STAR and the Lee Kong Chian School of Medicine, 11 NCID Monthly Research Meeting seminars were conducted in 2022. The seminars covered research themes in the areas of antifungal drug resistance, mycobacterial infections, pathogen transmission, metalloproteinases in tuberculosis and Mycobacterium tuberculosis for drug development, respiratory tract infection and COVID-19, and characteristics of secreted dengue virus NS1. More than 1,100 participants attended the seminars.

Regional Expert Panel Discussion on COVID-19

The Regional Expert Panel Discussion is an informal, open sharing platform that discusses COVID-19 clinical insights and learnings. It brings together experts from around Asia to share best practices, data and experiences, coupled with the latest scientific evidence.

Organised by the Pandemic Preparedness and Research Coordinating Office (PPRCO), four sessions have been held so far, each with different focus areas defined according to regional pandemic context and areas of interests proposed by attendees. The fourth session was held on 18 January 2022 where 27 clinical and research experts, representing nine countries across Asia, discussed endemicity, the national strategy on the road to normalcy, and how Omicron changed the game plan. A fifth session on 29 June 2022 focused on pandemic exit strategy, vaccine and booster policies and coverage, and seroprevalence studies with the goal of strengthening future outbreak response.

STRENGTHENING CAPABILITY IN INFECTIOUS DISEASE RESEARCH THROUGH PREPARE

Building on the lessons learnt from the fight against COVID-19, PREPARE focuses on the containment of future infectious disease threats by strengthening Singapore's research capabilities, translational platforms and expertise.

Official Launch of PREPARE

PREPARE was officially launched on 3 November 2022 by Minister for Health Mr Ong Ye Kung. The ceremony was attended by distinguished guests from supporting public agencies, research, medical and academic institutions across Singapore.

PREPARE was set up to support and strengthen Singapore's key research capabilities, translational platforms, and expertise to develop tools, methods and products that can be tapped on to detect, respond to, and contain future infectious

disease threats. Singapore's experience during the COVID-19 pandemic has illustrated how important research insights could be tapped on to support policy formulations, backed by sound scientific evidence. It also highlighted the areas where Singapore could strengthen its research capability and preparedness for the next pandemic. PREPARE, through the development of a national epidemic research and development (R&D) plan, will boost Singapore's efforts towards a faster and more decisive pandemic response. PREPARE strives to develop strong and synergistic partnerships across disciplines and sectors, facilitate knowledge sharing, and collaborate in clinical trials with various institutions.

PREPARE's Steering Committee and leadership team comprise representatives from key stakeholders across the R&D ecosystem, including A*STAR, DSO National Laboratories, Duke-NUS Medical School, MOH, NCID and its NPHL, National Environment Agency (NEA), National Healthcare Group, NUH, NUS, NTU, and Singapore General Hospital. NCID serves as the administrative host of PREPARE.

(From left to right) Official launch of PREPARE by Prof Wang Linfa, PREPARE Executive Director, Mr Ong Ye Kung, Minister for Health, and Prof Tan Chorh Chuan, Co-Chair of PREPARE Steering Committee

There are five co-operative programmes established under PREPARE – i) Analytics, Disease and Behaviour Modelling; ii) Environmental Transmission and Mitigation; iii) Diagnostics, iv) Vaccines and Therapeutics, and v) Regional Networks. These co-operatives are supported by PREPARE's two essential core capabilities – a national biorepository for clinical samples, tissues and associated data, and infectious diseases clinical and research databases. To complement the official launch, the PREPARE website was made accessible to the public on the same day.

Biosafety Level-3 Workshop

On 18 July 2022, PREPARE organised the inaugural Biosafety Level-3 (BSL-3) Workshop which aimed to establish a national cooperative workgroup, harmonise work activities and protocols, run collaborative projects, identify constraints, and anticipate bottlenecks.

Attendees of the inaugural BSL-3 Workshop

The workshop was attended by 25 key representatives from BSL-3 facilities and government agencies across the country including A*STAR Infectious Diseases Labs; Animal Veterinary Services (National Parks Board); DSO National Laboratories; Duke-NUS Medical School; Environmental Health Institute (NEA); Lee Kong Chian School of Medicine, NTU; MOH; NPHL (NCID); Temasek Life Sciences Laboratory; and Yong Loo Lin School of Medicine, NUS.

Following the workshop, PREPARE will continue to work with the key BSL-3 representatives to enhance coordination across infectious disease facilities in Singapore.

PREPARE Seminar with Prof Deborah Williamson

PREPARE hosted Prof Deborah Williamson, Director, Victorian Infectious Diseases Research Laboratory (VIRDL) at NCID on 29 November 2022 to explore research collaboration possibilities between VIDRL and PREPARE/NCID. Following a series of meetings and a tour of the NCID facilities, Prof Williamson conducted a hybrid seminar for 85 attendees across the academia, research and healthcare communities. Titled 'Translating Innovative Diagnostics into Practice during a Pandemic', her talk reviewed major innovations in clinical and public health microbiology during the COVID-19 pandemic and ways in which these innovations could be leveraged to enhance testing and surveillance for other infectious diseases. PREPARE looks forward to collaborating and working closely with VIDRL in the future.

PREPARE International Advisory Panel Review Meeting and Seminar

PREPARE held its inaugural International Advisory Panel (IAP) Review Meeting on 21 and 22 September 2022. The IAP is chaired by Prof Baron Peter Piot, a Handa Professor of Global Health and former director of London School of Hygiene & Tropical Medicine. IAP members include Dr Karin Bok, Director

of Pandemic Preparedness and Emergency Response at the Vaccine Research Center in National Institute of Allergy and Infectious Diseases (United States) and Dr Meera Chand, Director of Clinical and Emerging Infections at the UK Health Security Agency. Formally appointed in August 2022, the IAP was convened to provide guidance to PREPARE on its epidemic preparedness and response research strategy and implementation plans.

By tapping on the knowledge and experience of the IAP, PREPARE will be able to gain insights on major global epidemic preparedness and response research, and industry trends that may affect Singapore. The panel also provides an avenue for PREPARE to review and enhance its national strategy. The PREPARE IAP aims to convene every 18 to 24 months in Singapore, with ad-hoc virtual meetings every three to six months, to further the agenda of Singapore's epidemic preparedness and response research strategy.

The PREPARE IAP Seminar was also held on 22 September where IAP members gave a series of talks and participated in a panel discussion to share their experiences in fighting through epidemics past and present. Moderated by Prof Wang, the seminar was attended by over 30 senior leaders from the infectious diseases field, academia, public hospitals and ministries.

PREPARE ED Prof Wang Linfa with Prof Deborah Williamson, Director, VIRDL who conducted a hybrid seminar focusing on 'Translating Innovative Diagnostics into Practice during a Pandemic'

Summary:

1. **NCID has received a total of approximately S$7 million in grants to support research on infectious diseases, many of which were coordinated and facilitated by IDRTO. The research efforts resulted in more than 120 publications, some of which were published in reputable and high impact journals.**
2. **A MoU between NCID and ICL was signed on 30 November 2022 to formalise a mutual commitment to a deeper partnership in research, education and training.**
3. **PREPARE was officially launched on 3 November 2022 by Minister for Health Mr Ong Ye Kung. PREPARE is a national programme set up by MOH, supported by MOH's NMRC, to support and strengthen Singapore's key research capabilities, translational platforms, and expertise to develop tools, methods and products that can be tapped on to detect, respond to, and contain future infectious disease threats. NCID serves as the administrative host of PREPARE.**
4. **NIDRCO has successfully conducted the first virtual NCID SRAB from 28 to 30 September 2022 where more than 50 representatives from MOH, research institutes, public healthcare clusters, medical schools and academic institutes attended the meeting.**

Contributed by:
Prof David Lye, Director, IDRTO; Ms Farah Haniff, Director, Research Operations, IDRTO; Ms Chai Siaw Ching, Manager, Research Office (RO), IDRTO; Dr Jocelyn Jin Yu, Manager, NIDRCO, IDRTO; Ms Ng Hooi Ling, Manager, SCRN, IDRTO; Ms Gayathri Dorairaju, Assistant Manager, NIDRCO, IDRTO; Ms Skanthakumar Thakshayeni, Assistant Manager, PPRCO/PREPARE Programme Office, IDRTO; Ms Siti Nurdiana Binte Abas, Senior Research Assistant, IDRL, IDRTO; and Mr Adrian Chua, Senior Executive, RO, IDRTO.

BUILDING INTERNATIONAL CONNECTIONS

FOR A HEALTHIER SG

STRENGTHENING GLOBAL CONNECTIONS AND COLLABORATIONS FOR OUTBREAK PREPAREDNESS

At the time of writing, the COVID-19 pandemic has entered its fourth year and remains a Public Health Emergency of International Concern. While battling COVID-19, the world has not been spared of other ongoing infectious diseases and looming emerging infections at different corners of the world is ever present. The one disease on the global horizon currently is an old disease – cholera. Over the past two years, more than 30 countries have reported cholera cases to the World Health Organization (WHO) with most cases in Malawi, Syria, Afghanistan etc. As at end 2022, close to 80,000 cases have been reported with a case fatality rate of more than 1 per cent. This is the solemn state of affairs in modern day medicine.

Prof Leo Yee-Sin,
Executive Director

What can we learn from these outbreaks and how can we be better prepared? First of all, as a small island state, Singapore has emerged as an efficient nation in its response to COVID-19. It has the world's lowest mortality and has not compromised essential medical services. Looking at the two national programmes in the National Centre for Infectious Diseases (NCID) – the National HIV Programme and National Tuberculosis Programme – both demonstrated continuity of care and prevention during the pandemic. While as a nation Singapore has done well against COVID-19, what we need to layer on is to strengthen international collaboration and global connectedness which will further enhance our ability to respond to the next outbreak. One good example is the early alert signal on cases of a novel coronavirus pathogen emerging in Wuhan, China which came from our counterparts in China before the official announcement of the first COVID-19 case in Singapore by the government or other official sources, and this was critical to validate the multitude of unofficial information.

Recognising the importance of being connected, NCID has embarked on global outreach focusing on strategic partnerships with countries in different continents that have attained a reasonable status in healthcare delivery and research capabilities. This however, is not exclusive and we allow opportunity to prevail. Given the nature of work at NCID, areas to develop international collaboration include training programmes, exchange fellowships, research, sharing of data and materials, exchange of information / experiences to strengthen health management, etc.

In Asia, we have begun fostering close communication with Japan, Korea and Thailand.

A combined team from NCID, Programme for Research in Epidemic Preparedness and REsponse and Lee Kong Chian School of Medicine made an official visit to Australia in October 2022. The visits to Peter Doherty Institute, Australian Centre for Disease Preparedness, The Kirby Institute and Sydney Institute for Infectious Diseases involved in-depth discussions about each institute's capabilities and programmes, tours of research facilities, and concluded with conversations regarding areas for potential collaborations. Following the visit, we anticipate future collaborations through Memorandum of Understanding (MoU) with the institutes.

We have also made established connections in Europe. We co-organised a joint symposium with Imperial College London (ICL) in 2021 and 2022 to explore areas of research priorities, complementary strengths, and avenues to further strengthen collaborative partnership. Shared research topics included COVID-19, infectious disease modelling, vaccination and immunity, to name a few. We also signed an MoU with ICL on 30 November 2022 to formalise mutual commitment to a deeper partnership in research, education and training. INSERM in France is another partner in Europe which we have maintained contact following their official visit in September 2021. NCID has organised meeting with INSERM in March 2022 to identify potential areas of research shared by the two institutions. NCID also facilitated a meeting discussion where experts from NCID, Environmental Health Institute, Agency for Science, Technology and Research and National University of Singapore met up with the team from Arbo-France, a French multidisciplinary and multi-institutional network for monitoring, surveillance and research on human and animal arobovirus, in June 2022 to share arbovirus research work in Singapore and discuss potential collaborations. Following the meeting, the experts from Singapore will discuss how to bring the collaboration forward with the Arbo-France team.

With the United States, the adhoc mpox virtual sharing at the National Emerging Special Pathogens Training and Education Center Global Rounds in September 2022 was particularly helpful to prepare local clinicians for the 2022 mpox outbreak. Additionally, research collaboration with the National Institutes of Health, started during the early days of the COVID-19 pandemic, has continued with active participation on drug trials from remdesivir to monoclonal antibodies and new therapeutic agents coming online. The COVID-19 pandemic has exposed the need to build capacity in field epidemiology. The Singapore Field Epidemiology Training Programme put together by NCID and the National University of Singapore Saw Swee Hock School of Public Health has gained recognition and its progressive multisectoral approach attracted much interest to work with us, especially in incubating new ideas and novel training methods. Our faculty are working with the US Centers of Disease Control and Prevention's Center for Global Health and regional field epidemiology training networks (SAFETYNET, ASEAN+3 FETN) to develop a vibrant community of practice and technical support.

One of the successful ground up efforts was the setup of an informal regional sharing network with participation from experts from 11 countries in Asia. The aim of such a platform is to promote free sharing and exchange of information among clinicians. Discussion focused on COVID-19 such as variant of concern, surveillance, treatment, vaccination and boosters.

On the international partnership front, NCID responded to a call from WHO Global Outbreak and Response Network (GOARN) and deployed a small team from 20 September to 17 October 2022 to respond to the sharp increase in COVID-19 cases in the Republic of Marshall Islands and Federated States of Micronesia. The team from NCID reviewed workflows, and provided infection prevention and control (IPC) expertise and guidance to strengthen the local IPC practices in their hospitals and health centres. NCID's inputs were greatly appreciated by the local teams and the recommendations contributed to the improvement in IPC practices thus enhancing patient safety. We look forward to more opportunities for our staff to contribute to such international networks through their sharing of their public health and infectious disease expertise.

In 2022, NCID hosted 36 visits and meetings with counterparts from 24 countries. The discussions included COVID-19 pandemic response and lessons learnt, with the desire to establish similar infrastructure akin to NCID in their home country. This is a positive step toward strengthening health systems that will benefit beyond each country's border.

> "While as a nation Singapore has done well against COVID-19, what we need to layer on is to strengthen international collaboration and global connectedness which will further enhance our ability to respond to the next outbreak.

FORGING CONNECTIONS AND STRENGTHENING PARTNERSHIPS

By expanding its network of partnerships with organisations both locally and around the world, the National Centre for Infectious Diseases (NCID) hopes to contribute to knowledge and information exchange for increased cooperation in the fight against infectious diseases.

Hosting of senior management from SingHealth Community Hospitals, May

INTRODUCTION

By maintaining connections with local, regional, and international organisations, NCID seeks to facilitate communication and encourage collaboration.

LOCAL ENGAGEMENTS

In 2022, as part of efforts to strengthen local networks, NCID hosted staff from the Ministry of Manpower, as well as senior management and Singapore Field Epidemiology Training Programme Foundational Level (Tier 1) trainees from Singapore Food Agency. These visits offered opportunities for NCID to highlight its response to COVID-19 as well as its roles and responsibilities in Singapore's healthcare landscape.

NCID aims to share with local healthcare institutions on best practices in infectious diseases management and infection control. To this end, NCID hosted senior management from SingHealth Community Hospitals where it shared NCID's design principles and best practices related to infection control measures and workflows.

In addition, NCID hosted public healthcare institutions such as Changi General Hospital-Centre for Healthcare Assistive & Robotics Technology (CHART) to discuss experiences in digital technology adoption and deployment of robotics initiatives. NCID also shared with Jurong Health Services and Tan Tock Seng Hospital on the workflow processes at the NCID Outpatient Pharmacy which has incorporated smart technologies such as smart shelves into its operations.

REGIONAL AND INTERNATIONAL ENGAGEMENTS

The global fight against COVID-19 has led to NCID receiving requests from regional and international organisations keen to learn about NCID's strategies in infectious disease preparedness and management and to explore avenues for collaboration. Requests for visits were received from organisations in Armenia, Australia, Japan, Korea, Malaysia, Palestine, Switzerland, Thailand, United Kingdom and United States. Virtual meetings were also held with organisations in Israel and Norway.

Country	Organisation
Armenia	• National Center for Infectious Diseases
Australia	• East Metropolitan Health Service, Royal Perth Hospital • The Peter Doherty Institute for Infection and Immunity • The Royal Melbourne Hospital's Infection Prevention and Surveillance Service team
Israel	• National COVID-19 Information and Knowledge Center
Japan	• National Center for Global Health and Medicine
Korea	• Korea International Medical Association • Ministry of Health and Welfare • National Institute of Health • National Institute of Infectious Diseases • National Medical Center • Seoul National University Bundang Hospital
Malaysia	• Ministry of Health
Norway	• Centre for New Antibacterial Strategies, The Arctic University of Norway
Palestine	• The Palestinian Authority
Switzerland	• FIND (Geneva, Switzerland)
Thailand	• Bamrasnaradura Infectious Diseases Institute
United Kingdom	• Imperial College London • London School of Hygiene and Tropical Medicine
United States	• Gates Ventures

Guests from World Health Organization's Infection Prevention and Control Hub and Taskforce, July

Besides discussions related to COVID-19, conversations with these visitors also centred on topics pertaining to infectious disease research and training, public health and clinical services. These included infection prevention and control (IPC) measures; experience in building an infectious diseases hospital; setting up clinical facilities such as High Level Isolation Unit and negative pressure wards; clinical trials network; research in antimicrobial resistance, emerging infectious diseases, HIV, Tuberculosis; exchange of laboratory specimens and public health surveillance data and information; and boosting anticipatory preparedness, emergency planning and management capabilities.

NCID also welcomed members from the World Health Organization's Infection Prevention and Control Hub and Taskforce. Discussions centred on potential collaborations on IPC and NCID's IPC research.

NCID also hosted participants attending conferences in Singapore who were keen to learn about NCID functions and facilities. The participants were from the Building Alliances for Pandemic Response (Public Health) Asia (ALPHA) Fellowship Programme organised by National University of Singapore Saw Swee Hock School of Public Health's Leadership Institute for Global Health Transformation; the 25th Brunei Darussalam-Indonesia-Malaysia-Singapore-Thailand (BIMST) Public Health Conference, an annual meeting of the regional group of senior health officials from five countries in the Association of Southeast Asian Nations (ASEAN); the ASEAN Health Cluster 2 Meeting organised by ASEAN; and the Health Technology Assessment International (HTAi) Asia Policy Forum, an annual meeting to discuss heath technology assessment matters specific to Asia.

Throughout 2022, NCID had specially welcomed the following international guests who had expressed interest in learning about NCID's experiences in infrastructure development; response to COVID-19; IPC initiatives; research infrastructure and facilities; and Programme for Research in Epidemic Preparedness and REsponse (PREPARE):

- Dr Rabindra Abeyasinghe, World Health Organization Representative to Malaysia, Brunei Darussalam and Singapore
- Dr Stephan Atoyan, Director, Armenian National Center for Infectious Diseases
- Dr Daniel Bausch, Senior Advisor, Global Health Security at FIND and President, American Society of Tropical Medicine and Hygiene
- H.E. Mr. Md Tauhedul Islam, ndc, Bangladesh High Commissioner to Singapore
- Dr Khor Swee Kheng, Founder-CEO of Angsana Health and Chair of the ASEAN Business Advisory Council Healthcare Working Group
- Prof Heidi Larson, Founding Director of the Vaccine Confidence Project at the London School of Hygiene and Tropical Medicine who previously headed the Global Immunisation Communication at United Nations International Children's Emergency Fund and chaired the Global Alliance for Vaccines and Immunizations (GAVI) Advocacy Task Force
- Prof Peter Piot, former Director of the London School

Visit to a negative pressure ward for participants of HTAi Asia Policy Forum, November

Attendees at the first meeting of the APGN Steering Committee, June

of Hygiene and Tropical Medicine, founding Executive Director of the Joint United Nations Programme on HIV/AIDS (UNAIDS) and Under Secretary-General of the United Nations from 1995 until 2008

- Hon. Jaala Pulford, former Minister for Innovation, Medical Research and the Digital Economy, Victoria State Government, Australia
- Hon. Dr Ayesha Verrall, New Zealand Minister for Health; Research, Science and Innovation, New Zealand Government

In support of the World Health Organization's (WHO) call to build global pathogen genomics capability, the National Public Health Laboratory (NPHL) hosted the first hybrid meeting of the Asia-Pacific Pathogen Genomics Network (APGN) steering committee on 27 June 2022. The APGN aims to build regional capacity and enable sharing of pathogen genomics among public health laboratories, which is essential for future responses to outbreaks of communicable diseases. The meeting was attended by APGN members from Australia, Fiji, Japan, New Zealand and Singapore, as well as staff from the WHO's Regional Office for the Western Pacific to review pathogen genomics efforts in the region, establish the scope of APGN's activities and formulate next steps collectively. The occasion also marked the official launch of the APGN and its logo.

STRENGTHENING PREPAREDNESS AND CAPABILITIES THROUGH INTERNATIONAL STUDY VISITS

To expand epidemic preparedness and response capabilities, as well as develop new collaborations and strengthen existing partnerships, a delegation of eight from NCID, PREPARE, and the Lee Kong Chian School of Medicine participated in a study trip to four research institutes in Australia from 19 to 21 October 2022. Alongside experts and counterparts from The Peter Doherty Institute for Infection and Immunity, Australian Centre for Disease Preparedness, The Kirby Institute and the Sydney Infectious Diseases Institute, the delegation engaged in discussions on various aspects of infectious disease research. Since the visit, potential joint projects and areas of cooperation such as sharing of research samples, conducting joint symposiums and having visiting faculty exchanges between the institutions are being explored.

NCID will continue to maintain links with these research institutes by examining potential areas where further collaboration could take place through harnessing one another's strengths, seizing such experiences for learning and gaining further insights into the prevention and control of emerging infectious diseases.

CAPABILITY BUILDING THROUGH MEMORANDUMS OF UNDERSTANDING

NCID signed three Memorandums of Understanding (MoUs) with local and international partners in 2022. These MoUs are aimed at promoting research and knowledge sharing, enabling the exchange of expertise and resources, and enhancing training and education programmes.

NCID signed a letter of collaboration with the Rotary Club on 17 January 2022. The collaboration covers talks, Disease Detective Camp, and other community engagement

initiatives with Rotary Club Interactors, Rotaractors and other youths.

The NPHL signed the Standard Material Transfer Agreement 1 on 14 November 2022 to facilitate the contribution of biological specimens to the WHO BioHub. The WHO BioHub System serves as a repository of pathogens and their variants that can be shared with laboratories around the world. Since the MoU was signed, NPHL has sent two XBB isolates to the WHO BioHub Facility, Spiez Laboratory.

On 30 November 2022 a MoU was signed between NCID and Imperial College London (ICL) to formalise mutual commitment to a deeper partnership in research, education and training. The MoU was subsequently launched by Prof Leo Yee-Sin, NCID Executive Director and Prof Charles Bangham, ICL's Co-Director of the Institute of Infection via Zoom at the 4th joint Infectious Disease Symposium co-organised by NCID and ICL on 9 December 2022.

Summary:

1. **The 36 local, regional, and international engagements NCID hosted were a testament to its commitment to exchange knowledge and information for better cooperation in the fight against infectious diseases among the various organisations.**
2. **Leaders from NCID, PREPARE, and the Lee Kong Chian School of Medicine visited four Australian research institutes to expand epidemic preparedness and response capabilities, develop new collaboration, and strengthen existing partnerships.**
3. **Three MoUs were signed with local and international partners to promote research and knowledge sharing, enable the exchange of expertise and resources, and enhance training and education programmes.**

Contributed by:
Contributed by Antimicrobial Resistance Coordinating Office, Executive Director's Office, Infectious Disease Research and Training Office, National Public Health and Epidemiology Unit, NPHL, and NCID Pharmacy

PEOPLE MATTERS

FOR A HEALTHIER SG

SENIOR LEADERSHIP TEAM

01 02 03 04 05 06 07 08 09

1. **Professor Leo Yee-Sin**
   Executive Director
2. **Adjunct Assistant Professor Shawn Vasoo**
   Clinical Director
3. **Professor David Lye**
   Director, Infectious Disease Research and Training Office
4. **Adjunct Associate Professor Matthias Paul Toh**
   Director, National Public Health and Epidemiology Unit
5. **Adjunct Professor Raymond Lin**
   Director, National Public Health Laboratory
6. **Associate Professor Sophia Archuleta**
   Director, National HIV Programme
7. **Adjunct Associate Professor Jeffery Cutter**
   Director, National Tuberculosis Programme
8. **Adjunct Assistant Professor Monica Chan**
   Head, Department of Infectious Diseases
9. **Dr Margaret Soon**
   Director, NCID Nursing

10. **Mr Albert Tan**
Director, Operations, Executive Director's Office

11. **Dr Lee Tau Hong**
Head, Antimicrobial Resistance Coordinating Office

12. **Adjunct Assistant Professor Wong Chen Seong**
Deputy Director, National HIV Programme

13. **Dr Deborah Ng**
Deputy Director, National Tuberculosis Programme

14. **Dr Mark Chen**
Head, NCID Research Office, Infectious Disease Research and Training Office

15. **Dr Tan Seow Yen**
Head, Training and Education Office, Infectious Disease Research and Training Office

16. **Dr Ho Lai Peng**
Senior Principal Medical Social Worker, NCID Care and Counselling

17. **Ms Law Hwa Lin**
Senior Principal Pharmacist (Specialist), NCID Pharmacy

18. **Associate Professor Barnaby Edward Young**
Head, Singapore Infectious Disease Clinical Research Network, Infectious Disease Research and Training Office

19. **Adjunct Assistant Professor Kalisvar Marimuthu**
Clinical Lead, Healthcare-Associated Infections, National Public Health and Epidemiology Unit

ADMINISTRATIVE TEAM

01 02 03 04 05 06 07

1. **Ms Fiona Ng**
   Deputy Director, Finance, Executive Director's Office
2. **Ms Marion Abraham**
   Deputy Director, Corporate Communications, Executive Director's Office
3. **Ms Farah Binte Mohamed Haniff**
   Director, Research Operations, Infectious Disease Research and Training Office
4. **Professor Leo Yee-Sin**
   Executive Director
5. **Mr Albert Tan**
   Director, Operations, Executive Director's Office
6. **Ms Low Pui See**
   Deputy Director, Human Resource, Executive Director's Office
7. **Ms Hsieh I Jen**
   Deputy Director, Informatics, Executive Director's Office

NCID VISITING ADVISORS

The NCID Visiting Advisor framework was established to strengthen NCID's expertise network and facilitate knowledge sharing. In 2022, we formed collaborative engagements with the following public healthcare, research, and academic professionals.

Visiting Consultant

Associate Professor David Michael Allen
Yong Loo Lin School of Medicine,
National University of Singapore

Adjunct Associate Professor Ling Li Min
Infectious Disease Specialist,
Rophi Clinic

Associate Professor Hsu Li Yang
Saw Swee Hock School of Public Health,
National University of Singapore

ANTIMICROBIAL RESISTANCE COORDINATING OFFICE

Visiting Advisor

Clinical Professor Koh Tse Hsien
Department of Microbiology,
Singapore General Hospital

Clinical Associate Professor Tan Thean Yen
Laboratory Medicine,
Changi General Hospital

INFECTIOUS DISEASE RESEARCH AND TRAINING OFFICE AND PROGRAMME FOR RESEARCH IN EPIDEMIC PREPAREDNESS AND RESPONSE

Visiting Advisor

Associate Professor Sylvie Alonso
Department of Microbiology and Immunology,
Infectious Diseases Translational Research Programme,
Yong Loo Lin School of Medicine,
National University of Singapore

Vaccines and Therapeutics Co-operative,
Programme for Research in Epidemic Preparedness and REsponse

INFECTIOUS DISEASE RESEARCH AND TRAINING OFFICE

Visiting Advisor

Associate Professor Yeo Tsin Wen
Respiratory and Infectious Diseases Programme,
Lee Kong Chian School of Medicine,
Nanyang Technological University

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Respiratory and Infectious Diseases Programme,
Lee Kong Chian School of Medicine,
Nanyang Technological University

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Microbial Immunity Laboratory,
Agency for Science, Technology and Research Infectious Diseases Labs,
Agency for Science, Technology and Research

Professor Paul Anantharajah Tambyah
Division of Infectious Diseases,
Department of Medicine,
National University Hospital

Professor Wang Linfa
Programme in Emerging Infectious Diseases,
Duke-NUS Medical School

Visiting Investigator

Assistant Professor Zoe Jane-Lara Hildon
Saw Swee Hock School of Public Health,
National University of Singapore

Associate Professor Alex Richard Cook
Saw Swee Hock School of Public Health,
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Associate Professor Gan Yunn-Hwen
Infectious Diseases Translational Research Programme,
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National University of Singapore

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Lee Kong Chian School of Medicine,
Nanyang Technological University

Associate Professor Konstadina Griva
Health Psychology/Behavioural Medicine,
Lee Kong Chian School of Medicine,
Nanyang Technological University

Associate Professor Niranjan Nagarajan
Genome Architecture and Design,
Genome Institute of Singapore,
Agency for Science, Technology and Research

Dr Mo Yin
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Department of Medicine,
National University Hospital

Dr Sean Ong
Self-employed

Dr Shirin Kalimuddin
Infectious Diseases,
Singapore General Hospital

Professor Gavin James Smith
Programme in Emerging Infectious Diseases,
Duke-NUS Medical School

Professor May Oo Lwin
Wee Kim Wee School of Communication and Information,
Nanyang Technological University

Visiting Research Fellow

Dr Andrew Teo Chin Chye
Lee Kong Chian School of Medicine,
Nanyang Technological University

Dr Tan Kay Jin Rayner
Project China,
Institute for Global Health and Infectious Diseases,
University of North Carolina

Mr Muhamad Alif Bin Ibrahim
School of Social and Health Sciences,
James Cook University,
Singapore Campus

Visiting Scientist

Associate Professor Tan Boon Huan
Defence Science Organisation Biological Defence Programme,
Defence Science Organisation National Laboratories

NATIONAL PUBLIC HEALTH LABORATORY

Visiting Advisor

Associate Professor Chu Jang Hann, Justin
Department of Microbiology and Immunology,
Yong Loo Lin School of Medicine,
National University of Singapore

Dr Chan Su Gin Douglas
Department of Laboratory Medicine,
Ng Teng Fong General Hospital

Dr Sebastian Maurer-Stroh
Bioinformatics Institute,
Agency for Science, Technology and Research

Dr Teo Woon Pei, Jeanette
Department of Laboratory Medicine,
National University Hospital

NATIONAL TUBERCULOSIS PROGRAMME

Visiting Advisor

Associate Professor Hsu Li Yang
Saw Swee Hock School of Public Health,
National University of Singapore

PROGRAMME FOR RESEARCH IN EPIDEMIC PREPAREDNESS AND RESPONSE

Visiting Advisor

Associate Professor Tan Jek Chen Kelvin
Future Systems Office,
Infocomm Technology and Data Group,
Ministry of Health

Analytics, Disease and Behaviour Modelling,
Programme for Research in Epidemic Preparedness and REsponse

Dr Kang Chang Wei
Fluid Dynamics Department,
Institute of High Performance Computing,
Agency for Science, Technology and Research

Environmental Transmission & Mitigation,
Programme for Research in Epidemic Preparedness and REsponse

PEOPLE MATTERS

In 2022, our staff remained strong, trusted and united in protecting the people of Singapore from infectious diseases. Throughout the year, we celebrated the achievements of staff, showed appreciation for their hard work and fostered cohesiveness amongst staff through special events and engagement sessions.


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STAFF ENGAGEMENT AND APPRECIATION SESSIONS

Executive Director, Prof Leo Yee-Sin connects with staff from different departments and units regularly through informal engagement sessions.

NCID Senior Leaders also made time to visit staff from different departments and units to acknowledge staffs' efforts and distribute tokens of appreciation. These included visits to NCID Pharmacy, NCID Care and Counselling as well as National Public Health Laboratory and Infectious Disease Research Laboratory in conjunction with World Pharmacists Day, World Social Work Day and Medical Laboratory Professionals Week respectively.

As part of activities to commemorate Nurses' and PSAs' Day, NCID Senior Leaders paid a special visit to wards, Clinic J and Clinic K to extend their gratitude to nurses and Patient Service Associates. In addition, NCID Senior Leaders visited wards, Clinic J, inpatient and outpatient pharmacies and the NCID Operations Command Centre on a Saturday in July 2022 to specially thank staff on duty.

Through such avenues of open communication and discussion, NCID Senior Leaders and staff build rapport whilst mutually supporting one another. These visits also gave staff opportunities to provide feedback and share experiences, concerns and challenges whilst collectively exploring solutions and greater support for daily operations.

1. World Social Work Day, March
2. Walkabout at NTBP and TBCC, March
3. Medical Laboratory Professionals Week, April
4. Clinical Department Get-together, April
5. Nurses' and PSAs' Day, August
6. World Pharmacists Day, September

COMMEMORATING SPECIAL OCCASIONS

Special occasions were commemorated with meaningful activities, as seen through the Family Day and Staff Appreciation Day held in September 2022 to mark NCID's third anniversary. Highlights of this milestone event included a heritage walk through the former Communicable Disease Centre's compound, guided tours of The NCID Gallery, game and food booths. Similarly, NCID's Year End Party 2022 had a series of activities based on the theme of "NCID Goes Green".

1. NCID Family Day, September
2. NCID Third Anniversary and Staff Appreciation Day, September
3. NCID Year End Party, December

HEALTH AND WELLNESS EVENTS

The importance of a healthy lifestyle is highly emphasised at NCID. A variety of health and wellness events were organised to encourage staff to embrace an active lifestyle. Spanning fitness programmes, dance classes, and outdoor physical activities, these events offered staff the opportunity to forge closer relations while keeping fit. Notable events included the Zumba, Yoga and Kpop Fitness classes facilitated by SportSG in August 2022 as well as regular outdoor running sessions initiated by staff.

Outdoor running session initiated by staff, August

AWARDS WON BY STAFF

Our staff have been recognised for their efforts and contributions in different areas. Here is the list of awards won by NCID staff in 2022.

32ND INTERNATIONAL CONGRESS OF ANTIMICROBIAL CHEMOTHERAPY

ISAC Young Investigator Travel Award - Best Oral Presentation Award

Dr Huang Zhilian, Senior Research Fellow, Infectious Disease Research and Training Office

ASIA PACIFIC COALITION ON MALE SEXUAL HEALTH (APCOM) HERO AWARD 2022

Health and Wellbeing Category

Adjunct Assistant Professor Wong Chen Seong, Deputy Director, National HIV Programme and Senior Consultant, Infectious Diseases

CLARIVATE HIGHLY CITED RESEARCHERS 2022

Professor David Lye Chien Boon, Director, Infectious Disease Research and Training Office

KNIGHT OF THE FRENCH ORDER OF THE LEGION OF HONOUR

Professor Leo Yee-Sin, Executive Director

LONG SERVICE AWARD

50 Years Long Service Award

Seenivasam Ambalakah, Health Attendant, Executive Director's Office

40 Years Long Service Award

Suryani Bte Maswan, Senior Enrolled Nurse I, NCID Nursing

30 Years Long Service Award

Mahmudah Bte Ibrahim, Executive Assistant, National Tuberculosis Programme

20 Years Long Service Award

Amy John, Nurse Clinician I, NCID Nursing
Lailani Zabat Casals, Senior Staff Nurse I, NCID Nursing
Tan Bee Har, Senior Staff Nurse I, Singapore Infectious Disease Clinical Research Network, Infectious Disease Research and Training Office

MINISTRY OF HEALTH NURSES' MERIT AWARD 2022

Joel Quek Wee Teck, Senior Staff Nurse I, NCID Nursing
K Renganathan, Assistant Nurse Clinician, NCID Nursing

NATIONAL AWARDS (COVID-19)

The Public Service Star (COVID-19)

Professor Leo Yee-Sin, Executive Director

The Public Administration Medal (Gold) (COVID-19)

Adjunct Assistant Professor Shawn Vasoo, Clinical Director
Dr Margaret Soon Mei Ling, Director, NCID Nursing

The Public Administration Medal (Silver) (COVID-19)

Professor David Lye Chien Boon, Director, Infectious Disease Research and Training Office
Adjunct Professor Raymond Lin Tzer Pin, Director, National Public Health Laboratory

The Public Administration Medal (Bronze) (COVID-19)

Associate Professor Barnaby Edward Young, Senior Consultant, Infectious Diseases
Adjunct Assistant Professor Monica Chan, Head, Infectious Diseases
Dr Mark Chen I-Cheng, Senior Consultant, National Public Health and Epidemiology Unit
Chen Jing, Senior Nurse Manager, NCID Nursing
Dr Cui Lin, Senior Principal Scientific Officer, National Public Health Laboratory
Dr Ho Lai Peng, Senior Principal Medical Social Worker, NCID Care and Counselling
Adjunct Assistant Professor Kalisvar Marimuthu, Clinical Lead, Healthcare-Associated Infections, National Public Health and Epidemiology Unit
Law Hwa Lin, Senior Principal Pharmacist (Specialist), NCID Pharmacy
Associate Professor Lim Poh Lian, Senior Consultant, Infectious Diseases
Lim Voon Ping, Senior Nurse Clinician, NCID Nursing
Lorraine Tan Yee Ching, Senior Nurse Manager, NCID Nursing
Ma Theresa Diamante Alandre, Senior Nurse Clinician, NCID Nursing
Adjunct Associate Professor Matthias Paul Toh Han Sim, Director, National Public Health and Epidemiology Unit
Dr Sapna Pradip Sadarangani, Consultant, Infectious Diseases
Albert Tan Hock Siong, Director, Operations, Executive Director's Office
Adjunct Assistant Professor Wong Chen Seong, Senior Consultant, Infectious Diseases
Julian Ng Chin Yew, Assistant Director, Executive Director's Office

The Commendation Medal (COVID-19)

Abdul Wahab Bin Hassan, Nurse Clinician I, NCID Nursing
Alice Binu, Nurse Clinician II, NCID Nursing
Alicia Chua Ai Yen, Senior Staff Nurse I, NCID Nursing
Ang Li Wei, Principal Medical Statistician, National Public Health and Epidemiology Unit
Arlene Ollero Cacho, Assistant Nurse Clinician, NCID Nursing
Benjamin Low Wei Yao, Nurse Clinician II, NCID Nursing
Bong Wai Cin, Senior Staff Nurse II, NCID Nursing
Boo Chek Kia, Nurse Clinician I, NCID Nursing
Brandon Vincent Lourdes, Executive, Executive Director's Office
Buenafe Jefrelle Lanzar, Assistant Nurse Clinician, NCID Nursing
Esabella Chan Leng Cher, Assistant Manager, Executive Director's Office
Dr Chan Yu Kit, Associate Consultant, Infectious Diseases
Dr Chia Po Ying, Consultant, Infectious Diseases

Dr Calvin Chiew Jing-Ye, Associate Consultant, National Public Health and Epidemiology Unit
Chong Kai Wei, Assistant Manager, Executive Director's Office
Dr Choy Chiaw Yee, Consultant, Infectious Diseases
Christine Gao Qiuhan, Deputy Director, Executive Director's Office
Daniel Tao Ghee De Peralta Chee, Senior Medical Social Worker, NCID Care and Counselling
Dr Ding Ying, Principal Research Fellow, Infectious Disease Research and Training Office
Diong Shiau Hui, Research Assistant, Infectious Disease Research and Training Office
Ignatius Ee Joo Meng, Manager, Executive Director's Office
Estee Tan Yidi, Senior Executive, Executive Director's Office
Dr Frederico Capulong Dimatatac, Principal Resident Physician, Infectious Diseases
Priscilla Fu Qixin, Nurse Clinician I, NCID Nursing
Dr Gao Qi, Senior Epidemiologist, National Public Health and Epidemiology Unit
Dr Go Chi Jong, Principal Resident Physician, Infectious Diseases
Dr Gutierrez Ramona Alikiiteaga, Assistant Director, Infectious Disease Research and Training Office
Helen Hii Shiu Sing, Senior Patient Service Associate, NCID Nursing
Hong Shi Ping, Senior Medical Social Worker, NCID Care and Counselling
Grace Hoo Si Ru, Senior Pharmacist (Specialist), NCID Pharmacy
Imrana Banu Khider Mohamed, Nurse Manager I, NCID Nursing
Dr Isais Florante Santos, Principal Resident Physician, Infectious Diseases
Janaki D/O Krishna, Patient Service Associate Supervisor, NCID Nursing
Jasmine Teo Shi Min, Senior Executive, Executive Director's Office
Ji Yang Yang, Senior Staff Nurse I, NCID Nursing
Jonathan Jordon Lim Cailu, Senior Research Assistant, Infectious Disease Research and Training Office
Ker Mei Fong, Patient Service Associate Assistant Supervisor, Specialist Clinic K
Kho Wei Lian, Senior Staff Nurse I, NCID Nursing
Lam Lan Hua, Senior Staff Nurse II, NCID Nursing
Law Yong Jian, Senior Staff Nurse II, NCID Nursing
Associate Professor Lee Cheng Chuan, Senior Consultant, Infectious Diseases
Adjunct Assistant Professor Lawrence Lee Soon-u, Senior Consultant, Infectious Diseases
Dr Lee Tau Hong, Senior Consultant, Infectious Diseases
Li Caihua, Nurse Clinician I, NCID Nursing
Lin Ying, Nurse Clinician I, NCID Nursing
Ling Ging Poh, Senior Staff Nurse II, NCID Nursing
Tovelle Loh Kyun Yen, Nurse Clinician II, NCID Nursing
Low Pui See, Deputy Director, Executive Director's Office
Lucius Tan Ren Jie, Senior Staff Nurse I, NCID Nursing
Lwa Ju Peng, Assistant Director, Infectious Disease Research and Training Office
Lydia Choong Jie Min, Senior Staff Nurse II, NCID Nursing
Mah Sui, Senior Healthcare Assistant I, NCID Nursing
Marion Abraham, Deputy Director, Executive Director's Office
Dr Mucheli Sharavan Sadasiv, Consultant, Infectious Diseases
Muhammad Syazwi Bin Mohammad Zain, Executive, Executive Director's Office
Nataline Tang Yan Ling, Senior Medical Technologist, National Public Health Laboratory
Nazirah Binte Mohd Nazari, Senior Patient Service Associate, NCID Nursing
Dr Deborah Ng Hee Ling, Consultant, Infectious Diseases
Ng Hooi Ling, Manager, Infectious Disease Research and Training Office
Ng Jiaxue, Manager, Executive Director's Office
Frank Ng Kwang Kiat, Manager, Executive Director's Office
Associate Professor Ng Oon-Tek, Senior Consultant, Infectious Diseases
Nichole Tan Xiu Lang, Assistant Nurse Clinician, NCID Nursing
Nur Ashikin Binti Sulaiman, Senior Staff Nurse II, NCID Nursing
Nur Hazlinda Binte Nasrom, Senior Staff Nurse I, NCID Nursing
Ong Ying Ying, Senior Pharmacist (Clinical), NCID Pharmacy
Jievanda Ow Shu Ying, Executive, Executive Director's Office
Paige Phoon Long Yoke, Assistant Nurse Clinician, NCID Nursing
Pang Jia Xin, Manager, Executive Director's Office
Pang See Jye, Executive, Executive Director's Office
Parrilla Ma Edselle Dongon, Senior Pharmacy Technician, NCID Pharmacy
Philip Tan Tiong Ghee, Deputy Director, Executive Director's Office
Phoon Yan Ling, Senior Staff Nurse I, NCID Nursing
Quek Yi Min, Senior Staff Nurse II, NCID Nursing
Reyes Raquel Buenviaje, Nurse Clinician II, NCID Nursing
Rovero Laurice Tolentino, Staff Nurse I, NCID Nursing
Salvador Clearvy Joy Diego, Senior Staff Nurse I, NCID Nursing
Samantha Koh An Qi, Medical Social Worker, NCID Care and Counselling
Dr Santhya, Epidemiologist, National Public Health and Epidemiology Unit
Seow Mui Hong, Senior Staff Nurse I, Specialist Clinic K
Crystal Sim Huiming, Senior Executive, Executive Director's Office
Siti Nasuhah D/O Abdul Naseer, Senior Executive Assistant, Executive Director's Office
Dr Suma Sathyanarayana Rao, Consultant, Infectious Diseases
Suraya Bte Masod, Senior Patient Service Associate, NCID Nursing
Tan Ya Ling Tiffany Bobo, Nurse Clinician II, Specialist Clinic K
Tan Yun Lin, Assistant Manager, Executive Director's Office
Felicia Tang Yun Li, Nurse Clinician II, NCID Nursing
Taton Vivian Bernadas, Senior Staff Nurse I, NCID Nursing
Dr Tay Jun Yang, Associate Consultant, Infectious Diseases
Teok Chew Hui, Assistant Manager, Executive Director's Office
Tien Wee Siong, Manager, Executive Director's Office
Tneh Yu Xuan, Senior Staff Nurse II, NCID Nursing
Wee Feng Yee, Pharmacy Technician, NCID Pharmacy
Yeo Jia Yee, Senior Staff Nurse II, NCID Nursing

The President's Certificate of Commendation (COVID-19)

National Centre for Infectious Diseases
National Centre for Infectious Diseases (COVID-19 Therapeutic Workgroup)
National Centre for Infectious Diseases (National Public Health Laboratory)

NATIONAL DAY AWARDS 2022

The Public Administration Medal (Bronze)

Adjunct Associate Professor Brenda Ang Sze Peng, Senior Consultant, Infectious Diseases

The Efficiency Medal

Dorothy Chng Siew Hong, Nurse Manager II, NCID Nursing
Win Mar Kyaw, Principal Epidemiologist, National Tuberculosis Programme

The Long Service Medal

Maria Elena Diche Mariano, Senior Staff Nurse I, NCID Nursing
Rashidah Bte Anwah, Patient Service Associate Supervisor, NCID Nursing

NATIONAL HEALTHCARE GROUP (NHG) AWARDS 2022

NHG Distinguished Achievement Award

Professor David Lye Chien Boon, Director, Infectious Disease Research and Training Office

NHG Young Achiever Award

Adjunct Assistant Professor Wong Chen Seong, Deputy Director, National HIV Programme

NHG Team Recognition Award (COVID-19)

COVID-19 Therapeutic Workgroup
Team members:
Adjunct Assistant Professor Shawn Vasoo, Clinical Director and Senior Consultant, Infectious Diseases
Associate Professor Barnaby Edward Young, Head, Singapore Infectious Disease Clinical Research Network and Senior Consultant, Infectious Diseases
Professor David Lye Chien Boon, Director, Infectious Diseases Research and Training Office and Senior Consultant, Infectious Diseases
Associate Professor Sophia Archuleta, Director, National HIV Programme
Adjunct Professor Raymond Lin Tzer Pin, Director, National Public Health Laboratory
Law Hwa Lin, Senior Principal Pharmacist (Specialist), NCID Pharmacy
Grace Hoo, Senior Pharmacist (Specialist), NCID Pharmacy
Dr Lee Tau Hong, Head, Antimicrobial Resistance Coordinating Office and Senior Consultant, Infectious Diseases
Adjunct Associate Professor Brenda Ang Sze Peng, Senior Consultant, Infectious Diseases
Dr Sapna Sadarangani, Senior Consultant, Infectious Diseases
Teok Chew Hui, Assistant Manager, Executive Director's Office

NCID Infection Prevention & Control (IPC) Outreach
Team members:
Adjunct Assistant Professor Kalisvar Marimuthu, Senior Consultant, Infectious Diseases
Dr Margaret Soon Mei Ling, Director, NCID Nursing
Lim Voon Ping, Senior Nurse Clinician, NCID Nursing
Tovelle Loh Kyun Yen, Nurse Clinician II, NCID Nursing
Paige Phoon Long Yoke, Assistant Nurse Clinician, NCID Nursing
Pang Jia Xin, Manager, Executive Director's Office
Teok Chew Hui, Assistant Manager, Executive Director's Office

National Public Health Laboratory (NPHL) - The Hidden Heroes of COVID-19
Team members:
Adjunct Professor Raymond Lin Tzer Pin, Director, National Public Health Laboratory
Dr Cui Lin, Senior Principal Scientific Officer, National Public Health Laboratory
Roger Chua Peng Jin, Laboratory Manager, National Public Health Laboratory
Dr Chavatte Jean-Marc Gilbert, Senior Scientific Officer, National Public Health Laboratory
Dr Benny Yeo Ken Yee, Scientific Officer, National Public Health Laboratory
Dr Daniel Lim Rui Xiang, Scientific Officer, National Public Health Laboratory
Dr Ding Yichen, Scientific Officer, National Public Health Laboratory
Seet Swee Kai, Principal Medical Technologist, National Public Health Laboratory
Loh Pei Ling, Senior Medical Technologist, National Public Health Laboratory
Siti Zulaina Bte Md Said, Senior Medical Technologist, National Public Health Laboratory
Nataline Tang Yan Ling, Senior Medical Technologist, National Public Health Laboratory
Ho Yu Ling, Senior Medical Technologist, National Public Health Laboratory
Teo Meng Li, Senior Medical Technologist, National Public Health Laboratory
Heng Wei Yun, Senior Medical Technologist, National Public Health Laboratory
Chen Shi Ling, Medical Technologist, National Public Health Laboratory
Chen Beibei, Medical Technologist, National Public Health Laboratory
Ma Weiyao, Medical Technologist, National Public Health Laboratory
Magalence Teng Wei Sin, Medical Technologist, National Public Health Laboratory
Zhou Zhenyang, Medical Technologist, National Public Health Laboratory
Teo Teck Hui, Medical Technologist, National Public Health Laboratory
Jesslin Tan Jie Ling, Medical Technologist, National Public Health Laboratory
Claudia Thng Ai Ling, Medical Technologist, National Public Health Laboratory
Royce Ang Boon Kiat, Medical Technologist, National Public Health Laboratory
Chung Miao Ling, Medical Technologist, National Public Health Laboratory
Samantha Ooi Chia Yi, Medical Technologist, National Public Health Laboratory
Nigel Chong Wu Chen, Medical Technologist, National Public Health Laboratory
Amanda Yong Hui Shi, Medical Technologist, National Public Health Laboratory
Tang Kai Xin, Medical Technologist, National Public Health Laboratory
Isaac Chia Zhuo Jun, Medical Technologist, National Public Health Laboratory
Alfred Wong Zhi Jie, Medical Technologist, National Public Health Laboratory
Samuel Loo Shi Hao, Medical Technologist, National Public Health Laboratory
Choo En Lin, Medical Technologist, National Public Health Laboratory
Jim Lee Jin Hui, Medical Technologist, National Public Health Laboratory
Su Shiqi, Medical Technologist, National Public Health Laboratory
Petrina Lim Pei Qin, Medical Technologist, National Public Health Laboratory
Jaclyn Kang Ying Ting, Medical Technologist, National Public Health Laboratory
Daniel Choong Zhi Yi, Medical Technologist, National Public Health Laboratory
Teo Chin Woon, Medical Technologist, National Public Health Laboratory
Farrah Chen Zhiyun, Medical Technologist, National Public Health Laboratory
Nadiah Binte Shaharuddin, Laboratory Executive, National Public Health Laboratory
Orzsebet Gethsemane Zhong Yunzhen, Laboratory Assistant, National Public Health Laboratory
Saratha D/O Ramachandran, Senior Executive Assistant, National Public Health Laboratory
Norfizah Binte Idris, Executive Assistant, National Public Health Laboratory

NCID Clinical Outbreak Response Team
Team members:
Adjunct Assistant Professor Shawn Vasoo, Clinical Director
Adjunct Assistant Professor Monica Chan, Senior Consultant, Infectious Diseases
Adjunct Assistant Professor Wong Chen Seong, Senior Consultant, Infectious Diseases
Dr Margaret Soon Mei Ling, Director, NCID Nursing
Imrana Banu Khider Mohamed, Nurse Manager I, NCID Nursing
Priscilla Fu Qixin, Nurse Clinician I, NCID Nursing
Tovelle Loh Kyun Yen, Nurse Clinician II, NCID Nursing
Paige Phoon Long Yoke, Assistant Nurse Clinician, NCID Nursing

Benjamin Low Wei Yao, Nurse Clinician II, NCID Nursing
Alicia Chua Ai Yen, Senior Staff Nurse I, NCID Nursing
Sim Kah Cheng, Senior Staff Nurse I, NCID Nursing
Lim Mei Yen, Assistant Nurse Clinician, NCID Nursing
Ji Yang Yang, Senior Staff Nurse I, NCID Nursing
Liew Wei Qin, Staff Nurse II, NCID Nursing
Angel Hii Hie Mee, Staff Nurse II, NCID Nursing
Grace Chan Ngya Gyuin, Staff Nurse II, NCID Nursing
Ng Zhen Min, Staff Nurse II, NCID Nursing
Siti Naqiah Binte Mohamad Shukor, Senior Staff Nurse II, NCID Nursing
Janaki D/O Krishna, Patient Service Associate Supervisor, NCID Nursing
Goh Soh Hoon, Senior Patient Service Associate, NCID Nursing
Wilson Lek Xin Wei, Senior Patient Service Associate, NCID Nursing
Puvana Ravi Chandaran, Senior Patient Service Associate, NCID Nursing
Khor Wanye (Wayne), Senior Patient Service Associate, NCID Nursing
Joanna Cheng Shu Rong, Patient Service Associate, NCID Nursing
Jason Dass, Senior Patient Service Associate, NCID Nursing
Mazlan Bin Kaman, Health Attendant, NCID Nursing
Albert Tan Hock Siong, Director, Operations, Executive Director's Office
Frank Ng Kwang Kiat, Manager, Executive Director's Office
Siti Nasuhah D/O Abdul Naseer, Senior Executive Assistant, Executive Director's Office
Jasmine Teo Shi Min, Senior Executive, Executive Director's Office

NCID COVID-19 Vaccination Operations for Staff, Immunocompromised Patients and VIPs
Team members:
Adjunct Assistant Professor Wong Chen Seong, Senior Consultant, Infectious Diseases
Adjunct Assistant Professor Monica Chan, Senior Consultant, Infectious Diseases
Adjunct Assistant Professor Shawn Vasoo, Clinical Director and Senior Consultant, Infectious Diseases
Associate Professor Lim Poh Lian, Senior Consultant, Infectious Diseases
Adjunct Assistant Professor Kalisvar Marimuthu, Senior Consultant, Infectious Diseases
Adjunct Associate Professor Brenda Ang, Senior Consultant, Infectious Diseases
Dr Sapna Sadarangani, Senior Consultant, Infectious Disease
Professor Leo Yee-Sin, Executive Director
Frank Ng Kwang Kiat, Manager, Executive Director's Office
Jasmine Teo Shi Min, Senior Executive, Executive Director's Office
Christine Tin Jing Yi, Executive, Executive Director's Office
Siti Nasuhah D/O Abdul Naseer, Senior Executive Assistant, Executive Director's Office
Albert Tan Hock Siong, Director, Operations, Executive Director's Office
Esabella Chan Leng Cher, Assistant Manager, Executive Director's Office
Crystal Sim Huiming, Senior Executive, Executive Director's Office
Marion Abraham, Deputy Director, Executive Director's Office
Imrana Banu Khider Mohamed, Nurse Manager I, NCID Nursing
Rashidah Bte Anwah, Patient Service Associate Supervisor, NCID Nursing
Janaki D/O Krishna, Patient Service Associate Supervisor, NCID Nursing
Tan Zhi Hui, Senior Patient Service Associate, NCID Nursing
Goh Soh Hoon, Senior Patient Service Associate, NCID Nursing
Puvana Ravi Chandaran, Senior Patient Service Associate, NCID Nursing
Joanna Cheng Shu Rong, Senior Patient Service Associate, NCID Nursing
Lim Mei Yen, Assistant Nurse Clinician, NCID Nursing
Alicia Chua Ai Yen, Senior Staff Nurse I, NCID Nursing
Alice Ng Zhen Min, Staff Nurse II, NCID Nursing
Liew Wei Qin, Staff Nurse II, NCID Nursing
Grace Chan Ngya Gyuin, Staff Nurse II, NCID Nursing
Ji Yang Yang, Senior Staff Nurse I, NCID Nursing
Angel Hii Hie Mee, Staff Nurse II, NCID Nursing
Priscilla Fu Qixin, Nurse Clinician I, NCID Nursing
Siti Nur Asyikin Binte Abdul Hafiz, Senior Staff Nurse II, NCID Nursing
William Kho Wei Lian, Senior Staff Nurse I, NCID Nursing
Lai Jo Shin, Senior Staff Nurse I, NCID Nursing
Benjamin Low Wei Yao, Nurse Clinician II, NCID Nursing
Tovelle Loh Kyun Yen, Nurse Clinician II, NCID Nursing
Paige Phoon Long Yoke, Assistant Nurse Clinician, NCID Nursing
Dr Margaret Soon Mei Ling, Director, NCID Nursing
Mazlan Bin Kaman, Health Attendant, NCID Nursing
Law Hwa Lin, Senior Principal Pharmacist (Specialist), NCID Pharmacy
Ong Ying Ying, Senior Pharmacist (Clinical), NCID Pharmacy
Lim Jia Hui, Senior Pharmacist (Clinical), NCID Pharmacy

NCID Operations Command Centre - Joint Crisis Call Centre (NOCC - JCC)
Team members:
Albert Tan Hock Siong, Director, Operations, Executive Director's Office
Philip Tan Tiong Ghee, Deputy Director, Executive Director's Office
Ignatius Ee Joo Meng, Manager, Executive Director's Office
Teok Chew Hui, Assistant Manager, Executive Director's Office
Christine Gao Qiuhan, Deputy Director, Executive Director's Office
Jievanda Ow Shu Ying, Executive, Executive Director's Office
Muhammad Syazwi Bin Mohammad Zain, Executive, Executive Director's Office
Brandon Vincent Lourdes, Executive, Executive Director's Office
Lwa Ju Peng, Assistant Director, Infectious Disease Research and Training Office
Tien Wee Siong, Manager, Executive Director's Office
Tan Yun Lin, Assistant Manager, Executive Director's Office
Estee Tan Yidi, Senior Executive, Executive Director's Office
Pang See Jye, Executive, Executive Director's Office
Esabella Chan Leng Cher, Assistant Manager, Executive Director's Office
Goh Chin Jack, Senior Executive, Infectious Disease Research and Training Office
Gayathri D/O Dorairaju, Assistant Manager, Infectious Disease Research and Training Office
Jenny Ng Sock Mun, Assistant Manager, Infectious Disease Research and Training Office
Samantha Poon, Manager, Infectious Disease Research and Training Office
Runni Nadia Mohd Simm, Assistant Manager, National Tuberculosis Programme
Teo Jieming, Senior Executive, National Tuberculosis Programme

NHG QUALITY DAY 2022 AWARDS

Quality Improvement Award (Merit Award for Improving and Sustaining Quality and Safety)

NCID ICU Retrieval Process for Intubated Patients (Sustainability Phase) Project
Team members:
Lim Voon Ping, Senior Nurse Clinician, NCID Nursing
Li Caihua, Nurse Clinician I, NCID Nursing
Nichole Tan Xiu Lang, Assistant Nurse Clinician, NCID Nursing
Lee Wan Lih, Senior Staff Nurse I, NCID Nursing
Ling Ging Poh, Senior Staff Nurse I, NCID Nursing

Quality Improvement Award (Best Award for Innovation in Healthcare)

"Time to Take the Pressure off": Reducing Facial Pressure Injuries from Non-Invasive Ventilation Project
Team members:
Lim Voon Ping, Senior Nurse Clinician, NCID Nursing
Joel Quek Wee Teck, Senior Staff Nurse I, NCID Nursing
Tneh Yu Xuan, Senior Staff Nurse II, NCID Nursing
Vincy Mathew, Senior Staff Nurse I, NCID Nursing
Lee Wan Lih, Senior Staff Nurse I, NCID Nursing
Lucius Tan Ren Jie, Senior Staff Nurse I, NCID Nursing
Chan Cui Peng, Senior Staff Nurse II, NCID Nursing
Helen Hii Shiu Sing, Senior Patient Service Associate, NCID Nursing

NHG RESEARCH & INNOVATION AWARDS 2022

NHG-LKCMedicine Clinician/Clinical Scientist Award

Professor David Lye Chien Boon, Director, Infectious Disease Research and Training Office and Senior Consultant, Infectious Diseases

NHG TEACHING AWARD

For Pharmacy Senior Preceptors

Ong Ying Ying, Senior Pharmacist (Clinical), NCID Pharmacy

NATIONAL MEDICAL EXCELLENCE AWARDS

National Outstanding Clinician Award

Associate Professor Lim Poh Lian, Director, High Level Isolation Unit and Senior Consultant, Infectious Diseases

SINGAPORE HEALTH AND BIOMEDICAL CONGRESS 2022 SCIENTIFIC COMPETITION

"Basic Science & Translational Research" – Merit

Hon Pei Yun, Senior Research Assistant, Infectious Disease Research and Training Office

"COVID-19: Our Response to a New Challenge (Poster)" – Merit

Dr Hao Ying, Principal Medical Statistician, National Public Health and Epidemiology Unit

Health Service Award

Dr Huang Zhilian, Senior Research Fellow, Infectious Disease Research and Training Office

SINGAPORE MEDICAL ASSOCIATION MERIT AWARD

Professor Leo Yee-Sin, Executive Director

SINGAPORE WOMEN'S HALL OF FAME

Professor Leo Yee-Sin, Executive Director

STANFORD UNIVERSITY'S TOP 2% SCIENTISTS 2022

Adjunct Assistant Professor Shawn Vasoo, Clinical Director
Associate Professor Lim Poh Lian, Director, High Level Isolation Unit
Adjunct Associate Professor Jeffery Cutter, Acting Director, National Tuberculosis Programme

THE EXCEPTIONAL STARS AWARDS

Exemplary Stars Award

Ward 11F - Inpatient Group A

Platinum Award

Outpatient Parenteral Antibiotic Therapy (OPAT) - Outpatient Group B

Titanium Award

Ward 14F - Inpatient Group A

TTSH'S 178TH FOUNDER'S DAY

Staff Excellence Award (Silver)

Badajos Juniera Villaver, Assistant Nurse Clinician, NCID Nursing

TTSH 2021 HAND HYGIENE COMPLIANCE AWARDS

NCID Wards 5F, 7E, 8E, 9E, 9F, 11F and 12E

TTSH CLINICAL EDUCATORS AWARD

Clinical Educators Award (Outstanding)

Lim Jia Hui, Senior Pharmacist (Clinical), NCID Pharmacy

Clinical Educators Award (Merit)

Audrey Goh Wei Ling, Senior Pharmacist, NCID Pharmacy

Support Staff Educator Award

Jehrald Timothy Chua Tiu, Pharmacy Technician, NCID Pharmacy

TTSH WONDERFUL OUTSTANDING WORK (W.O.W) AWARD

First Quarter:
Chee Xin Yi, Senior Staff Nurse II, NCID Nursing
Wang Ruijuan, Assistant Nurse Clinician, NCID Nursing

Second Quarter:
Mazlan Bin Kaman, Health Attendant, NCID Nursing
Rina Ho Choy Peng, Senior Patient Service Associate, NCID Nursing

Third Quarter:
Soh Yee Man, Assistant Nurse Clinician, NCID Nursing
Wilson Lek Xin Wei, Senior Patient Service Associate, NCID Nursing

** Designations reflected are as per when the awards were conferred or announced.*

STAFF STORIES

Looking back on 2022, here are some of our staff's personal thoughts and reflections as they recollect their most memorable experiences and proudest moments, while continuing to uphold high standards of work and care for our patients and the community and living out our mission to protect the people of Singapore from infectious diseases.

2022 was an exciting year with many interesting projects and workplace transformation initiatives. One noteworthy project was our migration to the Next Generation Electronic Medical Records (NGEMR) system. I am proud to have been involved in this national project, which aimed to better coordinate care and improve patient experiences.

One of my roles was to ensure that the NCID Pharmacy team was ready to embrace and execute the changes. Fortunately, I work with a great team who were able to rapidly adapt to and assimilate the new workflows. It was heartening to witness the camaraderie among the various family groups as we spent many hours ironing out workflows through constant communication and well-coordinated dry runs.

In the lead up to implementation day, the NCID Pharmacy team worked through the night to ensure that medication orders were transcribed accurately and supply given out promptly. The success of the NGEMR system was indeed a gigantic feat that would not be possible without the active participation and cooperation of all colleagues!

Kee Ya Ling

Senior Pharmacist (Clinical), NCID Pharmacy

An impactful project I am involved in at NCID is the INVEST trial. INVEST is a pragmatic, investigator-initiated, strategy trial that aims to evaluate the clinical efficacy and economic impact of early stepdown to oral antibiotics versus continuing intravenous therapy for uncomplicated Gram-negative bacteraemia. The trial is coordinated by Singapore Infectious Disease Clinical Research Network (SCRN), which provides support to more than 20 participating hospital sites in Singapore, Malaysia, South Korea, Australia, Israel, Lebanon, Turkey and several countries in Europe.

As a member of the SCRN team, I oversee various aspects of project and data management for clinical trials and studies, including the INVEST trial. I am proud to work at NCID where I have the opportunity to conduct meaningful research in collaboration with passionate clinicians and scientists both in Singapore and around the world.

Russel Lee

Senior Research Fellow, Singapore Infectious Disease Clinical Research Network, Infectious Disease Research and Training Office

2022 was especially challenging as I had to learn how to don personal protective equipment (PPE) and keep it on throughout my shifts. However, with the support, encouragement and understanding from my colleagues, I was able to adapt to wearing the PPE and carrying out my duties in it.

Having been with NCID since its days as the Communicable Disease Centre, I am happy to see all the positive changes that have taken place. Personally, I am still learning new things on the job daily, and I enjoy serving our patients and doing my best to attend to their needs. While some patients can sometimes be difficult to manage, seeing them gradually recover and eventually return home to their loved ones brings me much joy. It has been an exciting 24 years of service so far, and I hope to continue serving NCID for many more years to come.

Siti Safiah Bte Hanapi

Health Attendant, NCID Nursing

Although the Biosafety Level 3 (BSL-3) laboratory in the National Public Health Laboratory (NPHL) has been in operation since 2020, I first entered the laboratory in 2022 as a member of the BSL-3 team. An area where high-risk organisms are propagated under high containment facilities, BSL-3's laboratory procedures are usually more time-consuming and laborious compared to those in average laboratories due to the extreme precautions required when carrying out procedures as well as the need to don Powered Air Purifying Respirators (PAPR). The research performed in the BSL-3 facility is essential for the understanding of highly pathogenic viruses and bacteria.

NPHL has supported many outbreak investigations, including detecting the SARS-CoV-2 and mpox viruses. While our role is mostly behind the scenes, our duty of generating timely and accurate results facilitates contract tracing and aids in ring-fencing the spread of diseases during an outbreak. It gives me a sense of satisfaction to know that we play an important part in Singapore's healthcare system.

Loh Pei Ling

Senior Medical Technologist, National Public Health Laboratory

In 2022, I felt a great sense of accomplishment when I was able to fine-tune the decant workflows for a coordinated transfer of COVID-19 patients. I was determined to ensure that the work I did would facilitate a smooth transfer and provide better care for patients till de-isolation. Together, my team and I worked hard to ensure that the day's decant was completed timely and efficiently. I was grateful for the excellent teamwork and pleased to have had the opportunity to guide my new teammates and share my knowledge with them.

It was definitely a challenging period where my team and I had to cope with the surge of cases and the transition to NGEMR. Nevertheless, it was a rewarding experience to be part of the team to provide continuity of care to support a patient's journey. I am immensely gratified to be working alongside our NCID frontliners to curtail the spread of COVID-19. Looking back, 2022 has helped me understand that change is inevitable and it is vital to be prepared to embrace any storm that might come by.

Dakshahini D/O Balan

Executive, NCID Admin and Support, Executive Director's Office

The common response when people hear that I work in NCID is that it must be challenging being a healthcare worker. While it is hard work, it is harder to be sick and have no one to rely on for support. To me, it is the "heart work" that comes from the bonds forged with my patients, who come from different backgrounds with their own stories to tell.

I recall attending to a case in the Intensive Care Unit where a patient's daughter was grief-stricken for not admitting her mum sooner. Throughout the admission, I witnessed how relationships within the family were reconciled, despite the painful circumstances.

I am thankful to be able to journey with my patients and their families to build therapeutic relationships and create a safe space for them to share their experiences, joys and sorrows. The support from my supervisor and colleagues has also been invaluable in helping me grow as a medical social worker.

Samantha Koh An Qi

Medical Social Worker, NCID Care and Counselling

During the COVID-19 pandemic, many projects were put on hold. It was therefore thrilling that after years of planning and development, the pilot project for HIV self-testing kits (HIVST) was successfully launched in 2022. This is the first time that the use of HIVST has been approved in Singapore, and it is significant because of the potential impact it would have in our fight to end HIV infection. HIVST allows individuals to test in the privacy of their own home without fear or stigma, increasing the likelihood of them seeking treatment and breaking the chain of transmission.

It is a source of pride for me to be involved in this monumental project, which is only possible because I am working in NCID. NCID expands my role beyond that of a clinical physician, allowing me to be involved in national level projects that can benefit the lives of others.

Dr Choy Chiaw Yee

Consultant, Infectious Diseases

STAFF ARTWORK

"Hands with Heart" by Antimicrobial Resistance Coordinating Office

Handprints in vibrant colours represent NCID's different disciplines, expertise and efforts; smaller hearts the individual talents and passions. Each of these contribute towards NCID's collective vision of being strong, trusted and united in keeping Singapore safe from infectious diseases.

Being a part of the NCID HIV Programme is a privilege for me as I get to work with colleagues across various disciplines – such as HIV medicine, nursing, allied health, and public health – towards the common goal of improving HIV care. Despite being from different specialties, we are given the space to work closely and share our opinions and experiences to plan and implement initiatives from within and outside NCID to improve scientific HIV knowledge among healthcare professionals and the public.

Thanks to my multidisciplinary colleagues, the NCID HIV Programme has improved my research, nursing and HIV knowledge, and extended my networking circles. As a nurse in NCID, I realise it is essential to leave my comfort zone to connect with other healthcare professionals and work collectively to improve patient outcomes. I am proud to be part of such a fantastic team.

Chua Tiow Shen
Senior Staff Nurse, NCID Nursing

2022 marked the first five-year milestone of the National Strategic Action Plan (NSAP) on Antimicrobial Resistance. As part of the workgroup that developed the action plan, it has been gratifying to see the progress made in the past five years, not least the establishment of a national coordinating office and secretariat that has become key in driving the implementation of the NSAP.

On reflection, siting the Antimicrobial Resistance Coordinating Office within NCID has been entirely fitting and personally beneficial. It has been an enriching experience to work with and learn from the many passionate people I have met here at this intersection of healthcare, public health and clinical research.

Lin Yueh Nuo
Deputy Director, Antimicrobial Resistance Coordinating Office

There were a lot of preparations before the EPIC system went live on 30 July 2022. The most memorable one for me was the Conversion weekend on 10 July 2022. It was Hari Raya Haji, and together with two colleagues and our Clinic Manager Sister Imrana, we carried out the necessary preparatory work. It was a long and tiring day, but interesting. Colleagues from other clinics and departments were involved too. We were all new to EPIC but were fortunate to have the guidance and support from the team of NGEMR colleagues.

Since switching to healthcare from a 22-year career in the architectural industry, I have been attached to the NCID Clinic J for more than two years. Having experienced the COVID-19 surge period, EPIC system implementation, and learning the workflows involved as a Patient Service Associate, I have found my role to be highly rewarding, especially when patients express their appreciation for our service. I am proud to be a part of the big NCID family.

Goh Soh Hoon

Senior Patient Service Associate, NCID Nursing

My most memorable moment in 2022 was being part of the organising committee for NCID's World AIDS Day 2022 celebration. I was delighted to be part of an incredible team dedicated to raising awareness and educating healthcare workers and the public on HIV/AIDS. The programme included interactive presentations, panel discussions, and fun quizzes, and was highly rated by participants.

In addition, I am proud to be part of the NCID HIV Database team since 2009. We aim to improve the health and well-being of patients with HIV by providing data for programmatic and research purposes. We play a key role in monitoring and evaluating NCID's HIV clinical services by maintaining a comprehensive clinical database to guide the programme's continuous development and improvement. My team and I also produce data for the Ministry of Health, Joint United Nations Programme on HIV/AIDS (UNAIDS) reports, National Public Health Laboratory projects, and HIV-AIDS-related research.

My team and I will continue to collaborate with the multidisciplinary team members from the clinical, nursing, care and counselling, and pharmacy departments who are part of the NCID HIV Programme.

Ohnmar Pa Pa Seinn

Senior Executive, National HIV Programme

STAFF ARTWORK

"Protecting the people of Singapore from infectious diseases" by Imrana Banu Khider Mohamed, Nurse Manager, NCID Nursing

Futuristic depiction of an NCID officer addressing concerns with artificial intelligence technology.

In 2022, I was privileged to lead a team at the Pandemic Preparedness Research Coordinating Office in the planning and execution of the Fourth Regional Expert Panel Discussion on COVID-19. Participants included 27 clinical and research experts representing nine countries across Asia. It felt like we had come full circle since our initial meetings in 2020 and 2021 which focused on treatment and vaccination. The regional representatives held the same level of enthusiasm and drive as they discussed national strategies on the road to normalcy amidst the challenges brought about by the Omicron variant.

With the official launch of the Programme for Research in Epidemic Preparedness and REsponse in November 2022, I am thankful for the opportunities to grow professionally and personally under the guidance of my team's leaders and colleagues. Being a part of NCID has been fulfilling, and I am proud to support NCID in its mission to protect the people of Singapore from infectious diseases.

Skanthakumar Thakshayeni

Assistant Manager, Pandemic Preparedness Research Coordinating Office, Infectious Disease Research and Training Office

Since joining NCID in April 2022, I have had the opportunity to work with teams from the National Public Health and Epidemiology Unit, and Programme for Research in Epidemic Preparedness and REsponse to analyse national data on COVID-19.

It was heartening to see our work influence national policies and public health response to the pandemic, and to improve our understanding of SARS-CoV-2 epidemiology. We had also strengthened our links with various stakeholders for greater data access and research translation. In addition, our efforts in building the National COVID-19 Surveillance Dashboard helped us better visualise the data gathered and monitor emerging variants.

I look forward to the growing role that data science will play in NCID to support evidence-based decision-making.

Dr Calvin Chiew Jing-Ye

Associate Consultant
National Public Health and Epidemiology Unit

The most challenging moment in my work in 2022 was during the tech refresh for the National Tuberculosis Programme (NTBP). The goal of establishing an efficient, reliable, and secure online platform for our users was achieved through the dedication, commitment, as well as close collaboration with the relevant teams. We were able to develop the key functional requirements for the system and complete scoring of the vendors' proposals under the tight timeline.

As a consultant at NTBP, I am honoured to be a part of the NTBP and NCID, a world-class organisation at the forefront of the fight against infectious diseases in the country. I also feel proud to have contributed to NTBP's review and discussions with the International Review Panel, and working with the NCID team to implement TB strategies in Singapore.

Dr Khin Mar Kyi Win

Consultant, National Tuberculosis Programme

ACKNOWLEDGEMENTS

We wish to place on record our grateful thanks to all NCID partners as well as colleagues who have contributed in one way or another, shared their valuable insights, and made this yearbook 2022 possible. Through their collegiality, this publication was a pleasure for us to produce. Above all, their professional efforts have helped to maintain Singapore's high standards in infectious diseases management and control.

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STAFF ARTWORK

"Feeling safe and protected by NCID" by Kelly Foo, Assistant Director, National Tuberculosis Programme

NCID is committed to our mission of protecting the people of Singapore from infectious diseases. We demonstrated our commitment during the COVID-19 pandemic by providing timely clinical care, public health advice and research insights. In this endemic phase of COVID-19, we will continue to work with our partners, collaborators and the community to strengthen our preparedness and capabilities to respond to the next pandemic.

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