

Mission control for pandemic preparedness

A*STAR Infectious Diseases Labs, in Singapore, addresses a range of diseases, from **COVID-19 AND ITS MUTATIONS TO MANY OTHER PATHOGENS**. Its mission includes defence against the next pandemic outbreak.

A hypothetical new infection called 'Disease X' that could spark the next global pandemic is on the World Health Organization's top ten priority diseases list. It could be even more transmissible and deadly than COVID-19.

"Until 2020, most people expected Disease X, the next pandemic, would be an influenza virus," says Lisa F. P. Ng, Executive Director of the A*STAR Infectious Diseases Labs (ID Labs) in Singapore. "Instead we now find ourselves in a coronavirus pandemic, which reinforces the message that we must be prepared for Disease X to arrive in any form, bacteria, virus, or parasite. We won't know until it happens," she says.

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ID Labs began formal operations in April 2021, when Singapore's lead public sector R&D agency, the Agency for Science, Technology and Research (A*STAR)

established the research entity as a frontline defence against future pandemics.

The structure emerged from A*STAR's COVID-19 response, Ng says, and will play a role in Singapore's five-year R&D Programme for Research in Epidemic Preparedness And Response (PREPARE), launched in December 2020.

"Infectious disease is interdisciplinary, and ID Labs has established important partnerships across A*STAR, hospitals and research institutions, and across global networks so we can respond quickly," Ng says.

ID Labs co-ordinates disease-specific research efforts that range from surveillance and detection, to diagnosis, treatment and vaccine strategies currently focused on COVID-19. These research efforts are designed to be rapidly adapted to a new pathogen if needed.

"Our aim is to find and stop any emerging pathogen before it can cause an outbreak," Ng says.

COVID-19 RESPONSE

"When the COVID-19 crisis struck, our researchers were able to pivot almost overnight to repurpose the knowledge we



Lisa Ng (middle), executive director, and Wendy Chen (right), research officer, observing cloned colonies of *E. coli* on agar plates, while Huang Yuling (seated), research officer, is performing plasmid purification.

had gained from our research on malaria, dengue fever, Chikungunya, Zika, and many other infectious diseases, thanks to deep capabilities that A*STAR has in infectious diseases research," says Ng.

"Singapore is in the tropics, where we come across many vector-borne, respiratory, viral and bacterial infections. We had researchers who were very strong in their respective domains, but who were also able to apply their knowledge to respond to this new disease," she adds.

From the beginning of the COVID-19 pandemic, A*STAR offered its resources towards Singapore's national response, placing scientists in the thick of a fast-moving, real-life situation, applying

their knowledge to multiple collaborations with other institutions and laboratories.

Across the various A*STAR institutes, biologists were challenged to come up with new molecular and serological tests, computational researchers modelled airflow in trains, offices and restaurants. Ng's team worked closely with Singapore's clinical community to understand disease mechanisms in patients, and the difference in host response between mild and severe forms of the disease.

"We already had longstanding partnerships with the clinical community at the front line, so we were the natural partners when COVID-19 arrived, and from the principal investigators down, every single one of our staff worked very long hours

every day to get on top of this crisis," she says.

A*STAR worked closely with local partners such as the National Centre for Infectious Diseases (NCID), National University Health System (NUHS), and SingHealth, as well as regional and international collaborators.

The intense work and strategic collaborations have helped get research prototypes into clinical testing and out to the market for effective infectious disease prevention, control, and elimination.

FUTURE PLATFORMS

Matthew Tay, Young Investigator at ID Labs, is developing a platform to analyse a pathogen sample and identify both the antibodies against that pathogen,

and the epitopes on the pathogen that are responsible for antibody function.

"Because SARS-CoV-2 was similar to SARS-CoV, scientists immediately homed-in on the virus' spike Receptor Binding Domain (RBD), and quickly identified that Angiotensin-converting enzyme 2, or ACE2, was the receptor to the SARS-CoV-2 virus," says Tay, an early-career researcher who joined the Singapore Immunology Network at A*STAR in 2018.

"Similarities with SARS-CoV was a critical discovery for vaccine design, but we may not be so lucky with the next potential epidemic-causing pathogen, which could be a virus, a bacterium, or a parasite. Our next challenge could be more complex," says Tay.



Amit Singhal (standing), principal investigator, and Artemis Milne (seated), PhD student, discussing flow cytometry data from bacterial infections.



Lum Fok Moon, senior research fellow at ID Labs, using cell culture techniques to better understand how human cells respond to EV71 infection.

For this reason, Tay's epitope-discovery platform must be highly flexible. "We don't know what Disease X will look like - so we need to build responses that we can adapt to any number of possible scenarios," says Ng.

Ng says Tay's work is an example of the deep capabilities ID Labs will build to apply to any future pandemic, and ID Labs are continuing to hire international researchers in areas such as bacterial, viral, and antimicrobial resistance.

GLOBAL SCHOLARS

In an increasingly globalized world, new infectious diseases emerge frequently and spread rapidly - and Ng says that COVID-19 has demonstrated how critical it is for researchers to build collaborative

international relationships.

"We want to attract talent like Matthew from all over the world, to collaborate with our senior investigators," says Ng.

Ng says that ID Labs will expand their skills, techniques and tools via a 'horizontal technology programme,' establishing new collaborations and identifying techniques from other disciplines.

"By bringing in different disciplines, ideas, and perspectives, we hope to build even broader and deeper capabilities," she says. ■



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