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Local biological defence capabilities to get boost with upcoming maximum security lab

(From left) DSO's director for biological defence Gladys Tan, threat surveillance and response programme director Yvonne Lau and senior member of technical staff Lim Jie Hui. PHOTO: DSO NATIONAL LABORATORIES

Lim Min Zhang

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SINGAPORE - Should a highly dangerous infectious disease hit Singapore, laboratories here are not equipped to handle the pathogens in such a way that potential treatments and containment strategies can be tested, and vaccines developed.

Such deadly, risk-group-4 viruses include Ebola, which has an average death rate of 50 per cent among those infected.

But by 2025, DSO National Laboratories will open Singapore's first biosafety level 4 (BSL-4) lab. It will cost about $90 million, Defence Minister Ng Eng Hen had announced in March.

The new lab, equipped with the highest level of safety measures, will boost local capabilities in dealing with the deadliest diseases - both known and as yet unknown to man - while keeping lab personnel and the community safe, DSO staff told The Straits Times last week (July 13).

Dr Gladys Tan, 45, director of the biological defence programme at DSO, said: "Having our own, in-country BSL-4 capability - both in terms of infrastructure as well as technical competency - will ensure Singapore's self-reliance and the ability to prioritise our own needs and interests during any future pandemics."

The team's mission is not only to be on the alert for infectious diseases that could pose a threat to the operational readiness of the Ministry of Defence and the Singapore Armed Forces (SAF). Unconventional threats such as biological warfare agents are also on the radar.

For instance, soon after the Sept 11 terrorist attacks in the United States in 2001, anthrax-laced letters were sent to several media outlets and politicians there, with apparently copycat cases in Singapore.

Government and private buildings here received letters laced with powder, which DSO helped to test, said Dr Yvonne Lau, 44, programme director of its threat surveillance and response programme.

The letters turned out to be hoaxes. "But this incident started the series of work for other biothreat agents of concern," she said.

"Subsequently, we developed assays for other higher-risk pathogens, such as the plague agent and tularemia. We also included things like smallpox, even though it has been eradicated, as we never know what are the potential risks."

A diagnostic assay, in this instance, is a test developed to determine the presence or absence of a pathogen (bacteria or virus), or antibodies against the pathogen.

"For the anthrax testing, we committed to provide the preliminary results in 12 hours, and a confirmatory result in 24 hours. So this really gives assurance to the services, either the SAF or the police, that they can have an answer fairly quickly," she said.

The new BSL-4 facility will be based on DSO's premises on Marina Hill, to complement its existing BSL-3 labs, and is scheduled to be operational by end-2025.

It will be part of at least 59 BSL-4 labs around the world - under construction or already in operation - in more than 20 places, including the US, Britain, China, India, Japan and South Korea.

In Singapore, there are eight BSL-3 labs, including two operated by DSO, constructed in 2001 and 2004.

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Although DSO has not yet encountered any unknown pathogen that required the help of labs overseas, it is not taking things for granted.

It has developed detection capabilities for Ebola and can do so safely in existing BSL-3 labs, said Dr Tan, 45. When there were two suspect Ebola cases in Singapore in 2014, the lab was able to come up rapidly with tests to detect and diagnose the samples.

"However, with BSL-3 labs and facilities, we can only detect the presence of Ebola in the clinical specimens, and we can't do anything beyond that," she added.

Should a Disease X - caused by a hypothetical pathogen that is highly infectious, deadly and can mutate easily - appear in Singapore, without a BSL-4 lab, DSO would be able to detect it, but it would not have the "end-to-end capability" to fight it, she said.

"We won't be able to develop rapid therapeutics or prophylactics, we can't do the decontamination strategies, we would not be able to understand how the pathogen can stay in the air or linger in the environment, so our capabilities will be hampered."

The new facility will not just be in place to react to future pandemics, but will also be used for research and development to build up its defences.

Singapore can gain access to risk-group-4 pathogens from overseas collaborators, said Dr Tan, who joined the now-defunct Defence Medical Research Institute in 1998 as a microbiologist and has a doctorate in immunology from the Johns Hopkins School of Medicine in the US.

The pathogens can then be grown in the BSL-4 facility and inactivated to generate reference materials to develop rapid detection and diagnostic assays. How the pathogen impacts cells, how it is transmitted and how long it persists in the air can be better understood.

"With this information, we can then come up with a range of various strategies that we can use to inactivate the virus. This will be work done during peacetime," Dr Tan said, adding that building up such competency and confidence is critical in preparing for the outbreak of an unknown virus.

The upcoming lab will ensure the safety of both lab personnel as well as that of the community at large, she said. The team will don positive air pressure suits with piped in air. "It's a completely sealed bubble, an astronaut kind of set-up."

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Air will be sucked out of the room constantly, and it will undergo a double-layer Hepa filtration so pathogens can be removed. A BSL-3 lab, in comparison, usually has only one layer of Hepa filtration.

The lab will have multiple air locks and negative pressure gradients, so air is constantly sucked into the facility, besides having an air corridor around it. This is to make sure air does not leak into the community.

Other than the infrastructure, Dr Tan stressed the importance of having and keeping good talent, given the difficulty in recruiting people in Singapore with experience in high-containment facilities.

Among some 40 staff in the biological defence team at DSO, about 30 are trained in working in the BSL-3 facility, and most have 10 to 15 years of experience. This will be the group trained for BSL-4 lab work, said Dr Tan.

They include Ms Lim Jie Hui, 36, a senior member of technical staff at DSO's threat assessment lab who has been with the organisation for nine years.

Senior scientists like Dr Tan and Dr Lau would personally bring more junior staff like Ms Lim to the lab every day, including on weekends and public holidays, to check on research results and train them.

The common mission of the team is to work together to build up and maintain this technical competency to protect the country's soldiers and the public, said Dr Tan, who spoke of the passion and dedication of the team.

"To be able to train, work safely and confidently in a high-containment facility, to support the Ministry of Defence and the SAF and the nation when crisis calls, it is an honour and a privilege," she said.

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