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News Bite on PolyU's Innovation

World's Most Comprehensive Automated Multiplex Diagnostic System

Identifying up to 40 respiratory pathogens within an hour

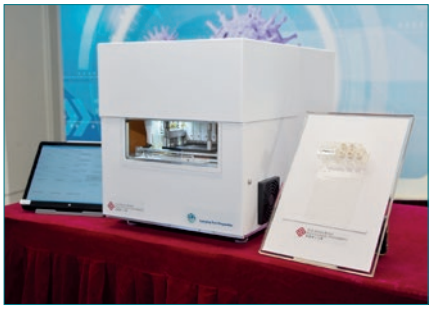
Both rhinovirus and novel coronavirus infections may cause similar symptoms. But the former is a common cold while the latter is a new strain that has claimed more lives than MERS and SARS. Physicians need a quick, accurate and economical way to tell the respiratory pathogens from one another. In light of this, researchers from the Department of Applied Biology and Chemical Technology developed an automated multiplex diagnostic system that identifies up to 40 respiratory viruses and bacteria, including the novel coronavirus, in one single test.

From left: Prof. Terence Lau, PolyU's Director of Innovation and Technology Development and Adjunct Professor of the Department of Applied Biology and Chemical Technology, Prof. Alexander Wai, Deputy President and Provost of PolyU, and Dr Manson Fok, Chairman of the Board of Avalon Biomedical Management Ltd., our project sponsor

Many viruses and bacteria can cause upper respiratory tract infection symptoms such as cough, sore throat, fever, runny nose and nasal congestion. Although there have been tests to detect multiple pathogens in the market, they are mostly designed for viruses and bacteria more commonly found in the U.S. and Europe, rather than in Asia. Those tests are also too expensive to most patients. The 2019 novel coronavirus (COVID-19) gives rise to symptoms similar to other respiratory illnesses, but it is highly infectious and has claimed more lives than MERS and SARS. The world is in urgent need of robust technologies that can quickly differentiate between different types of pathogen, so that appropriate and immediate measures can be taken to avoid large-scale spreading of diseases. In the past five years, Prof. Terence Lau, Director of PolyU Innovation and Technology Development and Adjunct Professor of the Department of Applied Biology and Chemical Technology, has been leading a research team to develop the world's most comprehensive rapid, automated multiplex diagnostic system that detects up to 40 infectious respiratory pathogens in one single test, including COVID-19. The machine is compact, portable, easy to operate, and can generate results quickly, making it the perfect point-of-care screening tool to be used in hospitals, clinics and ports.

The need for quick identification of pathogens

Many physicians face the dilemma of antibiotic use. Antibiotics only kill



The rapid, automated multiplex diagnostic system is capable of identifying up to 40 respiratory pathogens in one single test.

The rapid, automated multiplex diagnostic system is easy to operate and does not require minimal manual handling throughout the testing process.

bacteria, not viruses. Besides, the overuse of antibiotics can lead to antimicrobial resistance. However, certain bacterial infections call for timely prescription of antibiotics before the onset of more serious complications. Facing tens of patients with upper respiratory tract infection symptoms each day, physicians are desperately in need of a method to tell the pathogens quickly from one another, so as to break the chain of infection and to prescribe the right medicine. "In the past, each test can only identify one to three pathogens. That means if you want to test a sample for say 40 possibilities, you have to conduct the tests up to 40 times and it takes days. That's why I worked with my team to develop this compact automated multiplex diagnostic system that detects up to 40 viruses and bacteria in one single test, including influenza A viruses (H1, H2, H3), avian flu viruses (H5, H7, H9), human respiratory syncytial virus, severe acute respiratory syndrome coronavirus (SARS-CoV), Middle East respiratory syndrome coronavirus (MERS-CoV) and COVID-19. The results are ready within an hour, and the sensitivity is extremely high. It just needs five gene copies in the sample to give a positive result," explained Prof. Lau.

Bringing the cost down, enabling widespread use

There is a diagnostic test in the market that identifies 22 pathogens all at once, but it has not been popular in Hong Kong for its hefty price tag and because the target pathogens are not common in Asia. According to Prof. Lau, "Most diagnostics companies in the U.S. and Europe focus on testing for pathogens commonly found in their home countries. Pathogens common there are not necessarily the same ones we find here in Hong Kong. Besides, each test can cost up to several thousand Hong Kong dollars, meaning more comprehensive testing for 40 pathogens would cost even more. Thus, we need a system to identify pathogens which are prevalent in Asia, and we aim at bringing down the cost to around HK$200 to 300 per test."

Fully automated and time-saving

The rapid, automated multiplex diagnostic system is contained in a case not any bigger than an oven. After a multiplex microfluidic cartridge is inserted into the machine, the whole process is automated from there. "The machine automatically extracts and samples the nucleic acid, amplifies the DNA sequences with RT-PCR, mixes the sample with reagents, analyses the data and generates the results. It encompasses the latest advancements in bio-tech, microfluidics and production engineering and provides a cost-effective way to identify the pathogens," said Prof. Lau. A preliminary evaluations have been conducted at Queen Mary Hospital since late 2018. Mass production of the system could be possible within six to nine months, and at the same time, a more comprehensive clinical evaluation will be implemented.

Owing to its versatility, the system may be further developed for other medical uses such as cancer screening and even for non-medical uses such as food safety and environmental analyses in the future.