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Progress report on a pandemic

In the first of a series of editorials, we look back at some of the key findings from scientists' race to demystify the new coronavirus.

In the space of eight months, the new coronavirus SARS-CoV-2 and the disease it causes, COVID-19, have dominated the work of thousands of researchers in an unprecedented global effort.

In a series of editorials, we look back at key scientific findings that have revealed important characteristics of the virus and COVID-19, including emerging approaches to treatment and prevention. We begin, this week, with how the virus was identified; how it transmits between people; and the many ways in which it affects the human body.

Cracking the virus code

When an outbreak of a disease similar to severe acute respiratory syndrome (SARS) emerged in Wuhan, China, at the end of 2019, scientists suspected that a new coronavirus had spread to humans. Many of the first cases to be identified were linked to a single live-animal market in the city.

Researchers in China immediately began working to isolate and sequence the virus. When the original SARS virus, now known as SARS-CoV-1, emerged in humans in 2002, it took months to obtain a full sequence of the virus genome. This time, advances in sequencing technologies meant that scientists were able to unpick the virus's RNA code within weeks of the first cases appearing.

On 11 January, Yong-Zhen Zhang at Fudan University in Shanghai and his colleagues deposited the genome sequence of a virus isolated from a 41-year-old who had worked at the animal market into a public database. In doing so, they alerted the world to the existence of a new coronavirus that was related to SARS-CoV-1. Their findings were subsequently published in *Nature*[1].

Although Zhang's team had sequenced the virus from only a single patient, simultaneous work by other groups identified the same virus from other people with pneumonia. Together, these researchers firmly implicated this new coronavirus as the cause of the disease. One of the teams, led by Shi Zhengli at the Wuhan Institute of Virology, also determined that the closest known relative of the new virus was a bat coronavirus[2].

Not just a respiratory virus

Initial reports of the disease, named COVID-19 on 11 February, described a severe respiratory illness similar to that caused by SARS-CoV-1. Chest scans showed patchy shadows – known as 'ground glass opacities' – in the lungs of many patients, according to early studies from hospitals in Wuhan[3]. Moreover, older people, men and those with other diseases were more likely to be admitted to intensive care, whereas children seemed to have milder disease[4].

> "It quickly became apparent that SARS-CoV-2 is not just a respiratory virus."

But it quickly became apparent that SARS-CoV-2 is not just a respiratory virus. It also affects blood vessels, causing thrombosis[5] and strokes[6].

Autopsies have found the virus in organs other than the lungs, including the kidneys, liver, heart and brain, as well as in the blood[7]. We now know that symptoms of COVID-19 can include gastrointestinal, neurological, renal, cardiovascular and other complications[8].

Something in the air

It soon became clear that SARS-CoV-2 could hop from one person to another. This could happen through direct contact or indirect transmission, such as through droplets expelled during a cough, or even a simple exhalation. What wasn't clear – and is still a matter of debate – is how big those droplets need to be, and how far they can travel.

It's an important question. Larger droplets will quickly fall to the ground, but smaller, lighter ones – known as aerosols – can stay suspended in the air. A virus that can hitch a ride on such tiny droplets can travel farther and could raise the risk of infection in poorly ventilated indoor spaces.

The potential of the new coronavirus to travel in this way was the focus of a study, published in April, on SARS-CoV-2 aerodynamics in two hospitals in Wuhan[9]. Researchers found that some areas of the hospitals, particularly some staff areas, had relatively high concentrations of viral RNA in aerosol-sized droplets. The team did not determine whether those droplets were infectious.

Invisible disease

As the virus began to spread around the world, there were suggestions that people without symptoms might be able to transmit it.

In March, data from the cruise ship *Diamond Princess* revealed that 17.9% of those who tested positive for COVID-19 on the ship had no symptoms[10]. More than 3,700 people had been quarantined aboard the vessel in February after a former passenger was found to have COVID-19. In April, a study of 94 people showed that 'viral shedding' – the release of a virus into the environment – seemed to peak before or at the same time as the onset of symptoms[11].

We have come a long way in understanding how the pandemic arose and how it spread around the world – by studying the virus's characteristics and transmission, and how it causes disease. In future instalments of this editorial series, we'll look at the research on how to control it, as well as progress on treatments and vaccines.

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