STI SCIENCE TECHNOLOGY AND INNOVATION
COVID-19

Science, Technology and Innovation - Fighting the COVID-19 Outbreak

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Background

The current COVID-19 outbreak (caused by the SARS-CoV-2 virus) which began in Wuhan, China in late November 2019 has so far spread to 210 countries and territories and resulted in over 2 million cases and 137,000 deaths. It has led to socio-economic disruptions on a global and unprecedented scale. A global coordinated response to the outbreak was slow in taking shape. Policy makers underestimated the scope of the outbreak, and initially thought that it could be largely confined within China. The delays in disclosing information about cases from China, clamping down on international travel, and in declaring it a Public Health Emergency (on 30 January) and ultimately a pandemic (on 11 March) made control much more difficult. The resulting eruption of the outbreak has severely strained health systems world wide, and led to shortages of critical equipment such as protective masks and gowns, diagnostic kits, and ventilators.

About the SARS-Cov-2 Virus

The virus itself is not unknown. It belongs to the coronavirus family, which includes six other coronaviruses responsible for diseases in humans, such as MERS and the 2003 SARS outbreak. The original animal reservoirs are bats, and the virus is thought to have emerged as a human pathogen via an intermediate host such as the pangolin or the pig. The virion is medium sized, spherical in shape, of 50-200 nanometres diameter, encapsulating a single strand positive sense RNA virus[1] with a genomic length of about 30,000 base pairs. The other structural elements include the spike glycoprotein(S), envelope, membrane and the nucleocapsid (which contains the viral RNA). The virus attacks human cells by attaching the

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spike protein to a receptor ACE2 on the cell after which a sequence of events unfolds, leading to cell penetration, death and release of new virions. ACE2 receptors are more expressed in certain human cells found in the lungs, gastrointestinal tract, which is the reason for the SARS-Covid-2 virus's propensity to attack the lungs. Therefore, if we can block the fusion of the S spike protein with the ACE2 receptor, it would be a major advance.

The virus spreads mostly between people during close contact, via small droplets or aerosols produced by coughing, sneezing, or talking, aerosolization[2], or by touching a contaminated surface and then the face. Common symptoms include fever, cough and shortness of breath. Complications may include pneumonia and acute respiratory distress syndrome. The time from exposure to onset of symptoms is typically around five days, but may range from two to fourteen days. There is no known vaccine or specific antiviral treatment. Recommended preventive measures include hand washing, wearing face masks in public spaces, maintaining distance from other people, and monitoring and self-isolation for people who suspect they are infected.

Global Response to the Outbreak

Authorities worldwide have responded by implementing travel restrictions, quarantines, curfews and stay-at-home orders, workplace hazard controls, and facility closures. These have caused severe economic and social disruptions. Global socio-economic disruptions include the postponement or cancellation of political and cultural events, widespread shortages of supplies exacerbated by panic buying. Closures of educational institutions have affected 99.9 per cent of the world's student population. Misinformation about the virus has spread online, and there have been incidents of xenophobia and discrimination against people perceived as being from areas with high infection rates. Migrant workers have been doubly affected, firstly as a result of work stoppages leading to income reduction, and travel restrictions preventing them from returning to their original homes.

In the face of this situation, countries have launched major efforts to deploy science, technology and innovation to tackle the problems created by the outbreak. Economic policy measures and public information efforts are also under way

to tackle the economic and social consequences, but these will not be covered in this article. However it must be noted that efforts in all areas be it S &T, economic policy, social policy can be mutually reinforcing and produce synergies if properly managed.

Response to the Outbreak in India

The first case of the 2019–20 coronavirus pandemic in India was reported on 30 January 2020, originating from China. As of 16 April 2020, there were a total of 12,759 cases, 1,515 recoveries, and 420 deaths in the country. The infection rate of COVID-19 in India is reported to be 1.7, significantly lower than in the worst affected countries, probably due to energetic steps such as lockdown, face masks and social distancing promoted by the governments of the centre and the states. On 24 March, the Prime Minister ordered a nationwide lockdown for 21 days, affecting the entire 1.3 billion population of India.

On 14 April, the Prime Minister extended the on-going nationwide lockdown till 3 May. India is acknowledged to have tremendous capacity to deal with the coronavirus outbreak and, as the second most populous country, will have enormous impact on the world's ability to deal with it. But there is concern about the economic devastation caused by the lockdown, which has huge effects on informal workers, micro and small enterprises, farmers and the self-employed, who are left with no livelihood in the absence of transportation and access to markets. A gradual easing of restrictions is under way to alleviate these concerns.

India's External Engagement

On 26 February, India sent 15 tons of masks, gloves and other emergency medical equipment to China. On 13 March Prime Minister Modi proposed that SAARC nations jointly fight the pandemic, an idea that was welcomed by the leaders of Nepal, Maldives, Sri Lanka, Bhutan, Bangladesh, and Afghanistan. On 15 March, after a video conference of SAARC leaders, he allocated US$10 million of funds classified as COVID-19 Emergency Fund for the SAARC countries. This was welcomed by other SAARC countries and a further $ 11 million has been mobilised, including $ 3 million from Pakistan. On 11 April, India sent a team of 15 doctors and health care professionals to Kuwait to assist in its fight against Covid-19. India has sent 85 million hydroxychloroquine tablets and 500 million paracetamol tablets to 108 countries. In addition, 1 thousand tons of mixture have also been sent to make paracetamol tablets. Given India's large capacity for manufacture of drugs and pharmaceuticals, as well as medical devices and diagnostics, and protective equipment, telemedicine, human resources, and advanced medical care, it can make a major contribution to the global battle against COVID-19.

Global Research Road Map

WHO, in collaboration with the Global Research Collaboration for Infectious Disease Preparedness and Response (GLOPID-R), organised a Global Forum on research and innovation for COVID-19 ('Global Research Forum'). Over 400 participants from across the world participated. The Scientific Advisory Group of the WHO R&D Blueprint met on 2 March 2020 and reviewed the results, leading to the outcome document of a Global Research Roadmap with immediate, mid-term and longer-term priorities to build a robust global research response to the outbreak. Goals of the Global Research Roadmap are: (a) to facilitate that those affected are promptly diagnosed

and receive optimal care while integrating innovation fully within each research area, and (b) to support research priorities in a way that leads to the development of global research platforms pre-prepared for the next disease epidemic (an unexpected epidemic by a known or previously unknown pathogen); thus, allowing for accelerated research innovative solutions, and enabling R&D for diagnostics, therapeutics and vaccines as well as their timely equitable access. The coordinating role of WHO is essential to achieve optimum results from R & D efforts and access on affordable terms to the products and IPRs emerging from the R & D.

STI Actions across the World

There are several areas along which global STI efforts are focused. These are: (a) infection control and protection, related equipment, and contact tracing; (b) diagnostic tests and medical devices for treatment; (c) treatment with already approved drugs for other diseases and search for new drugs; and (d) development of vaccines and antibodies including those extracted from convalescent plasma. Research and development in all these areas is going on vigorously. Governments and other institutions have responded both with numerous STI programmes targeting COVID-19, as well as funding of STI. WHO recently announced a multinational clinical trial named SOLIDARITY for potential coronavirus therapies as part of an aggressive effort to jumpstart the global search for drugs to treat COVID-19.

There are multiple attempts in progress to develop a vaccine against COVID-19. The Coalition for Epidemic Preparedness Innovations (CEPI) – which is organising a US$2 billion worldwide fund for rapid investment and development of vaccine candidates – indicated in April that a vaccine may be available under emergency use protocols by early 2021. By April 2020, 115 vaccine candidates were in development, with two organisations having initiated Phase I-II safety and efficacy studies in human subjects. Five vaccine candidates were in Phase- I safety studies in April. Some 79 companies and academic institutions are involved in vaccine development. 10 different technology platforms were under research and development during early 2020 to create an effective vaccine against COVID-19.

STI Actions in India

India has engaged very actively in all the above areas of activity, with government and the private sector taking several initiatives. Among the many products being developed and other activities are affordable ventilators, area sanitising agents, disinfection gates and tunnels, IT applications such as Aarogya Setu, diagnostic devices and related IT applications, trials for repurposed drugs against Covid-19, vaccine development, etc. The list of these activities is growing rapidly as researchers across India are getting fully involved. NITI Aayog, Principal Scientific Adviser to the Government of India, ICMR are coordinating the effort, which includes many Ministries and research institutions. Many of these products and technologies have wide potential applications and relevance to other countries, especially developing countries. More detailed coverage appears in our fortnightly *Science Diplomacy Alerts*.

Conclusion

The struggle against COVID-19 is multisectoral, multidimensional, multinational and unprecedented. The SARS-Cov2 virus will most likely remain a long term threat to humanity. Achieving herd immunity while maintaining low mortality and morbidity requires the deployment of an effective and affordable vaccine which may take up to 18 months. Multiple waves of outbreaks of COVID-19 are likely. Therefore, R&D efforts must continue on a war footing along with social engineering to control outbreaks and availability of medical facilities to treat victims. There is no one size fits all solution and solutions must be tailored to conditions in each country. The prospect of emergence of new viruses from animal reservoirs will require more intensive R&D and efforts to elucidate the mechanisms through which viruses and pathogens can migrate across species. The regulatory framework for so-called "gain of function" research on pathogens needs to be strengthened to ensure that unfortunate incidents do not occur. International cooperation in all these areas is essential.

Endnotes

[1] According to the Baltimore classification of viruses

[2] Aerosolization involves dispersal of small sized particles containing the virus into the air, by for example, excessive shaking of contaminated gowns, etc. Such particles can remain suspended in the air for longer times and travel further up to about 10 metres depending on air speed.