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EDITORIAL

Nano Research for COVID-19

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The coronavirus infectious disease (COVID-19), which started in late 2019, was found to be caused by the SARS-CoV-2 virus. This virus has already infected hundreds of thousands of people and led to tens of thousands of deaths, with the numbers still rising quickly as of this writing, affecting essentially every country around the world.[1] Initial infections were discovered in December 2019 in the Hubei Province of China. Those infected presented with pneumonia-like symptoms and abnormal lung computed tomography (CT) images. Samples from infected patients were screened by the use of a multiplex polymerase chain reaction (PCR) panel of known pathogens. It yielded negative results. On January 10, 2020, the previously unknown pathogen was identified through next-generation sequencing as an RNA virus.[2] Its genome sequence showed that the novel virus was similar to SARS-CoV, the virus that caused severe acute respiratory syndrome (SARS) in 2002−2003, and it was named SARS-CoV-2.

The availability of the whole genome sequence enabled researchers to develop PCR kits to diagnose patients suffering with COVID-19. Researchers have also developed isothermal amplification tests, serological tests, and lateral flow assays to diagnose COVID-19.[3] However, regulatory approvals of these different tests by the various health agencies vary by country.

In parallel with diagnostic test developments, researchers are examining different drug formulations to treat patients suffering with COVID-19. One potential therapy currently undergoing clinical trials is the HIV drug combination of liponavir−ritonavir. Thus far, the trials have not shown a significant difference between patients treated with this drug cocktail and placebo.[4]

Finally, on the disease prevention front, a number of vaccine candidates are being repurposed against SARS-CoV-2, and some have recently entered phase I clinical trials.[5] A deployable vaccine is not expected for at least 12−18 months.

> The nanotechnology community can contribute significantly in the fight against COVID-19.

If COVID-19 persists beyond this year, we must adjust our research to address the significant stress that COVID-19 places on our healthcare systems. The nanotechnology community can contribute significantly in the fight against COVID-19. Nanomaterials have been used for the development of point-of-care diagnostics, carriers for therapeutics, and vaccine development. We recommend a number of research targets for the nanotechnology community:

(a) ***Rapid point-of-care diagnostics.*** Persons infected with SARS-CoV-2 present with a wide range of symptoms similar to other respiratory infections (*e.g.*, fever, cough, and shortness of breath) or may be silent carriers. Communal spread of COVID-19 is a major concern. The availability of a cost-effective, rapid point-of-care diagnostic test available to doctors in emergency rooms, clinics, and community hospitals is critical. These diagnostics enable frontline workers to triage patients simply and to prevent further spread of the virus.

(b) ***Surveillance and monitoring.*** Diagnostics are critical in determining the spread of an infection. Mass surveillance with rapid diagnostics helps public health officials monitor virus spread, proactively identify areas with increasing infections, anticipate surge capacity needs, and deploy needed resources to the appropriate areas. The success of such a system hinges on clear and transparent collaboration and communications between federal and state/principal public health laboratories, hospitals, government agencies, and communities. The World Health Organization and others have argued that widespread testing will be needed to stop this pandemic.[6]

(c) ***Therapeutics.*** Patients may need to be treated once individuals with COVID-19 are identified. These therapies block the replication of the virus in the host. Basic studies of the nano-bio interactions could be adapted to understand how SARS-CoV-2 infects their cells (*e.g.*, SARS-CoV-2 is 60−140 nm and binds to angiotensin converting enzyme receptor 2, ACE2), which can lead to new therapeutic agents and design.

(d) ***Vaccine development.*** Vaccines are instrumental in preventing disease by boosting the immune system against a pathogen. One vaccine being evaluated is a messenger RNA (mRNA)−lipid nanoparticle vaccine based on the previous studies of SARS-CoV and the Middle East Respiratory Syndrome (MERS).[5]

Life as we knew it before this pandemic has been forever altered. In the fight against COVID-19, research and technology development and deployment are our best weapons. Nanotechnology tools can be adapted to detect, to treat, and to

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prevent this disease. Our community has a chance to accelerate the translation of our developments and deploy nanotechnology advances as frontline tools. *ACS Nano* is here to help disseminate your contributions and strategies for fighting the COVID-19 pandemic.[3,7] We hope that you and yours are safe and well.

In the fight against COVID-19, research and technology development and deployment are our best weapons.

Announcement. As the spring European Materials Research Society meeting has been canceled, our *ACS Nano* award lectures[8] will be moved to a later date and venue.

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Notes

Views expressed in this editorial are those of the author and not necessarily the views of the ACS.

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