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Viewpoint

Science at Its Best in the Time of the COVID-19 Pandemic

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ABSTRACT: The COVID-19 (coronavirus disease 2019) pandemic has spread worldwide, leading to the deaths of millions and changing the way we live; we all hope to see the end of the pandemic soon. Nonetheless, an urgent need for medical interventions led to unprecedented and focused research efforts to translate scientific knowledge to new therapeutic and preventative interventions. Procedures were simplified, and new norms were established to expedite high-quality scientific output. We do hope that these changes will be adopted and streamlined to advance science in the future.

The COVID-19 pandemic has brought sorrow and death to the world, changed our current way of living, restricted work and travel, and scaled fear and grief to the level of whole populations. We all hope that the new vaccines and other prevention and therapeutic strategies will soon bring an end to the pandemic.

But for scientists, the COVID-19 pandemic has provided a vision and opportunity to see how science can work ideally. Researchers from distant disciplines are collaborating. Research materials are shipped immediately upon request by researchers, in many cases either without a material transfer agreement or while such an agreement is processed. Clinical trials are starting without delay. Journals are publishing new COVID-19 related data as soon as possible. Scientists are depositing their work on preprint servers for fast access. Authors are not filing patent applications to allow fast translation of their discoveries to COVID-19 therapy and prevention interventions. Editors of journals are providing flexible and extended timelines. Further, the National Institutes of Health is releasing notices to address specific research areas of interest related to the COVID-19 pandemic with a fast timeline of funding for successful applications.

This is science at its best: leading to new vaccines that are approved under emergency use authorization, to numerous clinical trials, and to tens of thousands of new publications providing invaluable insights from structural, biochemical, biophysical, and evolutionary studies of SARS-CoV-2 (severe acute respiratory syndrome coronavirus 2), the etiologic agent of COVID-19. Behind these efforts stands a strong basis that has been developed over years and decades and required intensive research work. Scientists from the NIH Vaccine Research Center have been working closely with researchers from Moderna on RNA-based vaccines against SARS-CoVs for years. Focused studies identified new ways to effectively stabilize different SARS-CoV spike proteins in the prefusion conformation, which was the basis for the development of the current RNA-based vaccine against SARS-CoV-2.[1] Research groups such as those led by Ugur Sahin and Drew Weissman separately and independently developed and optimized technology for efficient transcription and stabilization of mRNA to be used in vaccines.[2,3] Additionally, the pharmaceutical company Gilead has been developing for several years the broad antiviral drug remdesivir, which exhibits antiviral activity against replication of different viruses, including different CoVs and Ebola.[4] In addition, the availability of many drugs, which have been developed over decades and approved by the FDA for different indications, served as a source for repurposing approved drugs for blocking SARS-CoV-2 replication. But sharp and rapid transition from basic science insights into translational medicine that aims to block viral replication was evident with the urgent need for new means for interventions to change the course of the COVID-19 pandemic.

As the COVID-19 pandemic continued to spread worldwide, new bioinformatics tools have been developed and applied to provide updated data and to follow emergence of new SARS-CoV-2 variants.[5] Sequences of the full SARS-CoV-2 genome have been deposited at unprecedented rates, and investigations of different open reading frames in the SARS-CoV-2 genome identified potential targets for interventions.

We do hope to see the end of the pandemic as soon as possible, and we also hope that some of the procedures and norms that facilitated the generation of rapid, high-quality science output will be adopted and streamlined to advance science in the future.

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Notes

The authors declare no competing financial interest.

REFERENCES

(1) Corbett, K. S., Edwards, D. K., Leist, S. R., Abiona, O. M., Boyoglu-Barnum, S., Gillespie, R. A., Himansu, S., Schäfer, A., Ziwawo, C. T., DiPiazza, A. T., Dinnon, K. H., Elbashir, S. M., Shaw, C. A., Woods, A., Fritch, E. J., Martinez, D. R., Bock, K. W., Minai, M., Nagata, B. M., Hutchinson, G. B., Wu, K., Henry, C., Bahl, K., Garcia-Dominguez, D., Ma, L. Z., Renzi, I., Kong, W. P., Schmidt, S. D., Wang, L., Zhang, Y., Phung, E., Chang, L. A., Loomis, R. J., Altaras, N. E., Narayanan, E., Metkar, M., Presnyak, V., Liu, C., Louder, M. K., Shi, W., Leung, K., Yang, E. S., West, A., Gully, K. L., Stevens, L. J., Wang, N., Wrapp, D., Doria-Rose, N. A., Stewart-Jones, G., Bennett, H., Alvarado, G. S., Nason, M. C., Ruckwardt, T. J., McLellan, J. S., Denison, M. R., Chappell, J. D., Moore, I. N., Morabito, K. M., Mascola, J. R., Baric, R. S., Carfi, A., and Graham, B. S. (2020) SARS-CoV-2 MRNA Vaccine Design Enabled by Prototype Pathogen Preparedness. *Nature 586* (7830), 567−571.

(2) Holtkamp, S., Kreiter, S., Selmi, A., Simon, P., Koslowski, M., Huber, C., Türeci, Ö., and Sahin, U. (2006) Modification of Antigen-Encoding RNA Increases Stability, Translational Efficacy, and T-Cell Stimulatory Capacity of Dendritic Cells. *Blood 108* (13), 4009−4017.

(3) Pardi, N., and Weissman, D. (2017) Nucleoside Modified MRNA Vaccines for Infectious Diseases. *Methods Mol. Biol. 1499*, 109−121, DOI: 10.1007/978-1-4939-6481-9_6.

(4) Eastman, R. T., Roth, J. S., Brimacombe, K. R., Simeonov, A., Shen, M., Patnaik, S., and Hall, M. D. (2020) Remdesivir: A Review of Its Discovery and Development Leading to Emergency Use Authorization for Treatment of COVID-19. *ACS Cent. Sci. 6* (5), 672−683.

(5) Fernandes, J. D., Hinrichs, A. S., Clawson, H., Gonzalez, J. N., Lee, B. T., Nassar, L. R., Raney, B. J., Rosenbloom, K. R., Nerli, S., Rao, A. A., Schmelter, D., Fyfe, A., Maulding, N., Zweig, A. S., Lowe, T. M., Ares, M., Corbet-Detig, R., Kent, W. J., Haussler, D., and Haeussler, M. (2020) The UCSC SARS-CoV-2 Genome Browser. *Nat. Genet. 52*, 991−998.