OPEN ACCESS JOURNALS
Indiana Journal of Agriculture and Life Sciences
Abbreviate Tittle- Ind J Agri Life Sci
ISSN *(Online)*- 2583-1623
Journal Homepage Link- https://indianapublications.com/journal/IJALS
DOI: https://doi.org/10.5281/zenodo.21849037

INDIANA PUBLICATIONS
PRODUCTIVE AND QUALITY RESEARCH

Review Article

Volume-02|Issue-06|2022

Advances in Therapeutic and Diagnostic Strategies for COVID-19: A Review

Naina Srivastava

Botany Department, DAV PG College, Dehradun

Article History
Received: 28.11.2022
Accepted: 24.12.2022
Published: 29.12.2022

Citation
Srivastava, N. (2022). Advances in Therapeutic and Diagnostic Strategies for COVID-19: A Review. *Indiana Journal of Agriculture and Life Sciences, 2*(6), 30-34.

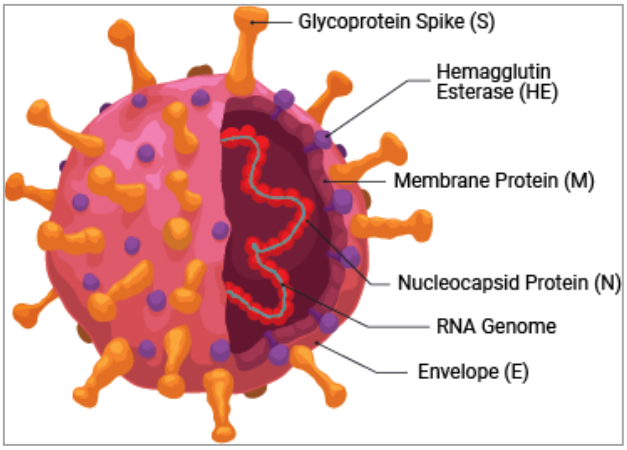
Abstract: SARS-CoV-2 is a novel coronavirus, which has the COVID-19 pandemic, thus challenging the healthcare systems of all countries and triggering an onslaught of rapid innovations in treatment and diagnosis solutions. This review explores the recent developments in the handling of COVID-19 with a special focus on the new diagnostic modalities and treatments. Selection of therapeutic agents, antiviral agents, immunomodulators, monoclonal antibodies and repurposed drugs are based on their action mechanisms and clinical efficacy. Molecular testing, antigen detection assays, serological assays and high-end imaging modalities in the context of diagnostic and surveillance are discussed. Combination therapies: More typically, immunomodulators are utilized in addition to antiviral medications to assist boost therapy efficacy, and artificial intelligence and machine learning is increasingly being accustomed to recognize cases earlier and more precisely. Pathophysiology of SARS-CoV-2 infection with its widespread inflammatory condition, impairment of various organs, and hypercoagulable is also addressed and the expertise in these mechanisms has been instrumental in developing the planned intervention. This review will aid in clarification by assessing the current literature the changing situation on the topic of COVID-19 management and direct the future research and the actions of the population healthcare.

Keywords: Corona, COVID-19, virus, pandemic, SARS-CoV-2

INTRODUCTION

The novel coronavirus SARS-CoV-2 and its unprecedented global spread, has ushered in a public health crisis on an unprecedented scale. COVID-19 pandemic has put healthcare systems, economies and societies under stress and created a need for effective therapeutic and diagnostic strategies. This review summarizes the current progress on the therapeutic and diagnostic strategies for COVID-19, based on the outcomes of the collaborative efforts of scientists, clinicians and public health workers to gain insights into the pathogenesis of the disease and design clinical interventions.

In the second part, certain of the new treatment solutions, re-purposed drugs, immunomodulators, and diagnostic solutions that are now accessible in recent history; and finally consider the bigger picture and opportunities that the world will face in response to the pandemic. SARS-CoV-2 is structurally arranged as illustrated in the figure below with the spike protein at the surface being the central focus of many therapeutic and diagnostic measures as discussed below.



Structure of SARS-CoV-2

THERAPEUTIC ADVANCEMENTS

Guidelines for treating COVID-19 have been provided by the Infectious Diseases Society of America (IDSA), which focus on evidence-based therapy such as administering corticosteroids in the severe illness and judicious use of monoclonal antibodies.

***Corresponding Author:** Naina Srivastava

Antiviral Agents

Numerous antiviral medications have been shown to be successful in preventing SARS-CoV-2 proliferation and lowering the virus load. By preventing the synthesis of viral RNA, the broad-spectrum antiviral drug remdesivir has been demonstrated to reduce recovery durations for hospitalized patients with severe COVID-19 (Beigel *et al*., 2020). A preliminary clinical trial in patients with mild to moderate disease showed a faster viral RNA clearance and fewer tests showing infectious virus was found in the participants when they took Molnupiravir, which is an antiviral agent taken by mouth (Fischer *et al*., 2021).

Immunomodulators

Severe COVID-19 (Mehta *et al*., 2020) can happen due to dysregulated immune response (cytokine storm/hyperinflammation). New treatment strategies, such as immunomodulatory treatments (including the use of corticosteroids and interleukin-6 (IL-6) inhibitors) have proven to be important treatments for reducing immune mediated damage. A powerful corticosteroid called dexamethasone has been found to decrease mortality in severely ill people by limiting excessive inflammatory responses (Horby *et al*., 2021). IL-6 inhibitors (tocilizumab and sarilumab) have been demonstrated to increase survival and reduce the requirement for organ support in critically ill COVID-19 pneumonia patients (Gordon *et al*., 2021).

Monoclonal Antibodies

SARS-CoV-2-specific spike there are known protein targets,as potential interventions to lower viral loads and halt disease progression in at-risk individuals. The two-antibody combinations (Regeneron's casirivimab-imdevimab and Eli Lilly's bamlanivimab-etesevimab) have been provided Emergency Use Authorization for the management of mild to moderate COVID-19 in non-hospitalized individuals who are more likely to become very sick (Chen *et al*., 2021). These treatments have proven to be effective in decreasing viral load and viral symptoms, and reducing hospitalisation, especially in high-risk populations.

Repurposed Drugs

Re-use of existing drugs has been an important aspect in accelerating COVID-19 therapeutics. Additionally, a variety of investigational drugs, including hydroxychloroquine, ivermectin, and favipiravir, are being investigated for their possible antiviral efficacy; however, none of these drugs have consistently shown promise in clinical studies. There was no evidence of a mortality benefit for hydroxychloroquine in hospitalised patients in a large randomised trial (RECOVERY Collaborative Group, 2020) and a randomised time to reaching a state of non-symptomatic illness between ivermectin and other treatments for mild disease (Lopez-Medina *et al*., 2021), and an According to an open label trial, favipiravir caused faster viral clearance than lopinavir-ritonavir (Cai *et al*., 2020) but evidence was limited. The safety issues and lack of a consistent body of evidence regarding effectiveness of their use continue to make them controversial. Anti-viral activity of Chloroquine and its derivative Hydroxychloroquine against SARS-CoV-2 was first considered; results from trials have been mixed and there have been reports of cardiac side effects. Combined, antiviral agents, immunomodulators, monoclonal antibodies and repurposed drugs provide promising options to lessen the intensity of COVID-19, but more research is required to understand their best use, effectiveness and security, in addition to the possibility of viral variants and drug resistance.

Nanomedicine in Therapeutics

There is a new therapeutic modality for nanotechnology, which provides systems for targeted medication delivery, enabling more efficient and bioavailable antiviral drugs (Sharma *et al*., 2021). The use of nanoparticle-based carriers to deliver Remdesivir directly to infected cells to minimize systemic toxicity is being investigated and Additionally, nanomaterials are utilized in vaccine development as an aid to antigen stability and controlled release. The technologies have been successful in preliminary trials that seek to optimise therapeutic outcomes and improve vaccine efficacy.

Combination Therapies

The synergic effects of antiviral drugs and immunomodulators have been studied in clinical investigations. These mixes are meant to lower the viral load, adjust the immune system, and prevent development of more severe complications such as cytokine storm. One study of phase 2 of treatment (Hung *et al*., 2020) showed that a combination therapy of interferon beta-1b, lopinavir-ritonavir and ribavirin shortened the viral shedding time compared with lopinavir-ritonavir alone in those with mild to moderate COVID-19, indicating that combined treatment might be more effective in the right patient.

DIAGNOSTIC STRATEGIES

Early and/or accurate diagnosis of COVID-19 is essential for COVID-19 management, containment of transmission and public health action. In recent years, the diagnostic technologies developed have broadened the spectrum of tools that can be applied to diagnose SARS-CoV-2 infection and to track the disease process.

Molecular Testing

For the diagnosis of acute SARS-CoV-2 infection, RT-PCR is still thought to be the most accurate diagnostic method (World Health Organization, 2020). The viral RNA is detected by RT-PCR assay from respiratory specimens and is used for most of the clinical and laboratory diagnosis worldwide because it has high sensitivity and specificity. Rapid molecular tests like loop-mediated isothermal amplification (LAMP) and further assays for nucleic acid amplification can give results quickly, accurately and lead to people who are

***Corresponding Author:** Naina Srivastava

infected being detected and appropriate infection control measures undertaken.

Antigen Detection Assays

An alternative to molecular testing is rapid antigen detection assays, which is a quick and affordable method (Watson *et al*., 2020). These are quick tests to identify viral antigens in respiratory samples and can be utilized in screening in the community, outbreak investigations and surveillance programmes, and can result in just minutes to hours. Antigen tests are simpler to administer, less sensitive than RT-PCR but more specific, thus they are considered as a valuable complement to mass testing programmes and in low-resource settings.

Serological Assays

Serological assays measure the presence of antibodies generated against infection with SARS-CoV-2, providing details on immune status (Sethuraman *et al*., 2020) and previous exposure. IgM, IgG and total antibodies against SARS-CoV-2 are typically detected by using enzyme-linked immunosorbent assays (ELISAs), lateral flow immunoassays and chemiluminescent immunoassays. Despite sensitivity and specificity variability, crossreactivity with other coronaviruses and time-dependent antibody decays are significant challenges to consider when considering these assays in seroprevalence studies, population immunity tests, and vaccine response.

Imaging Techniques

Chest computed tomography (CT), lung ultrasound, and further cutting-edge imaging methods are employed to support the diagnosis and treatment of patients with the disease COVID-19 (Rubin *et al*., 2020). Characteristic CT features, such as ground-glass opacities, consolidations, and crazy-paving patterns, aid early detection and risk stratification. Lung ultrasound is emerging as a useful method of measuring pulmonary involvement and clinical decision making particularly in resource constrained and critical care situations where CT may not be easily accessible. A combination of molecular tests, antigen detection, serological tests, and imaging can enhance the overall ability to detect and monitor SARS-CoV-2 infection and will be useful in controlling the disease and responding to the health of the population.

Artificial Intelligence in Diagnostics

The use of artificial intelligence and machine learning algorithms in diagnostic workflows to enhance accuracy of molecular and imaging based testing are being increasingly integrated. models for deep learning that can be applied to chest CT scans have been highly sensitive in differentiating COVID-19 pneumonia from other lung abnormalities, and predictive modelling is helping to identify the high-risk patients based on demographic and clinical features (Li *et al*., 2020).

Challenges in Rapid Testing

Although having a rapid antigen test has many benefits, it is not always 100% accurate due to factors like the amount of virus and when the sample was taken. These limitations will like the overcome with next-generation testing, utilizing assessments that are both fast like antigen testing and accurate like molecular testing.

CHALLENGES AND OPPORTUNITIES

COVID-19 responses create a variety of challenges and opportunities for healthcare systems, researchers, policy makers and communities around the world. The following areas continue to be key to strengthening the global response as the pandemic persists:

Variability in Testing Access and Capacity

Access to and capacity for testing continue to be a major hurdle in many areas to deliver effective detection and monitoring of transmission. Barriers exist for disadvantaged communities, rural areas and low-resource settings such as a lack of test supplies, insufficient laboratory infrastructure and logistical challenges. There is a requirement for increasing testing capacity, optimizing access to services and targeting interventions in underserved communities in order to address these disparities.

Emerging Variants and Evolution of the Virus

New SARS-CoV-2 variants have created challenges to current diagnostic test assays, therapeutics and vaccine efficacy (Abdool Karim & de Oliveira, 2021). The increased transmissibility, immune escape and resistance to therapeutics seen in some variants pose a risk to the authority of the pandemic and the quest for herd immunity. Surveillance, genomic sequencing, and live tracking of viral evolution still plays a critical role to detect new variants and monitor transmission patterns to guide public health measures.

Vaccine Distribution and Equity

While considerable strides in vaccine development and deployment have been made, equitable access continues to be a major challenge. A study of premarket purchase commitments revealed that early vaccine orders were placed by high-income countries, with the remainder of the world facing an uncertain future for vaccine access (So & Woo, 2020). Logistical challenges and vaccination hesitancy also impede full coverage, especially in low and middle income countries. In this regard, international collaboration, fair distribution systems and specific vaccination movements are crucial in ensuring that the most disadvantaged groups get served with the vaccine.

Health implications and post-COVID syndrome in the long-term.

***Corresponding Author:** Naina Srivastava

The long-term health consequences of COVID-19, also known as Long COVID, are a significant issue to health systems and to COVID-19 sufferers. Long-term effects of the COVID-19 might be manifested as fatigue, dyspnoea, cognitive impairment and mental health disorders, and will require a multidisciplinary approach to care (Mughees *et al*., 2021; Nalbandian *et al*., 2021). The burden of post-COVID syndrome needs to be mitigated by a longitudinal approach, rehabilitation programmes and patient-centred approaches to meet long-term needs of survivors.

Developing Strong Health Systems.

The COVID-19 pandemic has uncovered weaknesses and vulnerabilities in health systems around the world, and the necessity of resilience, preparedness and adaptive capacity. Infrastructure investments in healthcare and pandemic preparedness will be important in countering the effects of future health emergencies, and data-driven health strategies, telemedicine, and digital health technologies will help to enhance the provision and monitoring of healthcare.

Inequality in Booster Distribution across the world.

High vaccine coverage of boosters has been observed in wealthy nations, although there are numerous issues in low and middle income countries concerning the lack of resources and logistics. To tackle this imbalance, worldwide cooperation, local manufacturing centres and streamlined distribution networks are needed, ensuring that everyone has access to the products.

Future Preparedness Lessons.

With COVID-19, the world has a compelling need ensuring that everyone has access to the quickly to new threats. Investment in pandemic preparedness, including early warning, and stockpiling of essential supplies, remains a crucial issue that will help consequences of next-generation outbreaks.

CONCLUSION

COVID-19 has led to a global unprecedented effort to tackle an unprecedented public health crisis. A complex response has been necessary to effectively respond and this has involved therapeutics, diagnostics, public health interventions and science research. This review has shown how COVID-19 control has changed recently, as well as the potential and difficulties that lie ahead.

Innovations in treatment modalities like antiviral drugs, immunomodulators, monoclonal antibodies, and repurposed drugs offer the hope of improved clinical outcomes and have resulted in new treatment modalities that give clinicians more choice. While certain advancements have been made, they require more studies to determine their best use, efficacy, and safety, and to overcome the emerging and unresolved diseases like viral strains or possible resistance to the drugs. Simultaneously, diagnostic equipment has enhanced the capability at the molecular level, in terms of antigen detection, serological examinations and imaging procedures, thus assisting in timely diagnosis and response in the interest of the populace health.

Significant obstacles remain to be overcome, including disparities in testing access, vaccine access, and health systems, new variants, and the effects of theissue on health in the long term. In the meantime, the pandemic has already led to an unprecedented scale of scientific collaboration, the introduction of vaccines and new technologies in the tests and treatment within a short period of time, the rise in popularity of AI and data processing. Collaboration between scientists, clinicians, policy makers and industry partners via multidisciplinary cooperation is also essential to overcome the current COVID-19 pandemic and to be prepared to the next global health crisis.

REFERENCES

1. Abdool Karim, S. S. & de Oliveira, T. (2021). New SARS-CoV-2 variants-Clinical, public health, and vaccine implications. *New England Journal of Medicine, 384*(19), 1866-1868.
2. Beigel, J. H., Tomashek, K. M., Dodd, L. E., Mehta, A. K., Zingman, B. S., Kalil, A. C., Hohmann, E., Chu, H. Y., Luetkemeyer, A., Kline, S., Lopez de Castilla, D., Finberg, R. W., Dierberg, K., Tapson, V., Hsieh, L., Patterson, T. F., Paredes, R., Sweeney, D. A., Short, W. R., Lane, H. C. (2020). Remdesivir for the treatment of Covid-19-Preliminary report. *New England Journal of Medicine, 383*(10), 993-994.
3. Cai, Q., Yang, M., Liu, D., Chen, J., Shu, D., Xia, J., Liao, X., Gu, Y., Cai, Q., Yang, Y., Shen, C., Li, X., Peng, L., Huang, D., Zhang, J., Zhang, S., Wang, F., Liu, J., Chen, L., Liu, L. (2020). Experimental treatment with favipiravir for COVID-19: An open-label control study. *Engineering, 6*(10), 1192–1198.
4. Chen, R. E., Zhang, X., Case, J. B., Winkler, E. S., Liu, Y., Van Blargan, L. A., Liu, J., Errico, J. M., Xie, X., Suryadevara, N., Gilchuk, P., Zost, S. J., Tahan, S., Droit, L., Turner, J. S., Kim, W., Schmitz, A. J., Thapa, M., Wang, D., Diamond, M. S. (2021). Resistance of SARS-CoV-2 variants to neutralization by monoclonal and serum-derived polyclonal antibodies. *Nature Medicine, 27*(4), 717–726.
5. Fischer, W. A., II, Eron, J. J., Jr., Holman, W., Cohen, M. S., Fang, L., Szewczyk, L. J., Sheahan, T. P., Baric, R., Mollan, K. R., Wolfe, C. R., Duke, E. R., Azizad, M. M., Borroto-Esoda, K., Wohl, D. A., Coombs, R. W., Loftis, A. J., Alabanza, P., Lipansky, F., & Painter, W. P. (2021). *A phase 2a clinical trial of molnupiravir in patients with COVID-19 shows accelerated SARS-CoV-2 RNA clearance and elimination of infectious virus* [Preprint]. medRxiv.

***Corresponding Author:** Naina Srivastava

6. Gordon, A. C., Mouncey, P. R., Al-Beidh, F., Rowan, K. M., Nichol, A. D., Arabi, Y. M., Annane, D., Beane, A., van Bentum-Puijk, W., Berry, L. R., Angus, D. C. (2021). Interleukin-6 receptor antagonists in critically ill patients with Covid-19. *New England Journal of Medicine, 384*(16), 1491–1502.
7. Horby, P., Lim, W. S., Emberson, J. R., Mafham, M., Bell, J. L., Linsell, L., Staplin, N., Brightling, C., Ustianowski, A., Elmahi, E., Prudon, B., Green, C., Felton, T., Chadwick, D., Rege, K., Fegan, C., Chappell, L. C., Faust, S. N., Jaki, T., Landray, M. J. (2021). Dexamethasone in hospitalized patients with Covid-19-Preliminary report. *New England Journal of Medicine, 384*(8), 693–704.
8. Hung, I. F.-N., Lung, K.-C., Tso, E. Y.-K., Liu, R., Chung, T. W.-H., Chu, M.-Y., Ng, Y.-Y., Lo, J., Chan, J., Tam, A. R., Shum, H.-P., Chan, V., Wu, A. K.-L., Sin, K.-M., Leung, W.-S., Law, W.-L., Lung, D. C., Sin, S., Yeung, P., Yuen, K.-Y. (2020). Triple combination of interferon beta-1b, lopinavir–ritonavir, and ribavirin in the treatment of patients admitted to hospital with COVID-19: An open-label, randomised, phase 2 trial. *The Lancet, 395*(10238), 1695–1704.
9. Li, L., Qin, L., Xu, Z., Yin, Y., Wang, X., Kong, B., Bai, J., Lu, Y., Fang, Z., Song, Q., Cao, K., Liu, D., Wang, G., Xu, Q., Fang, X., Zhang, S., Xia, J., & Xia, J. (2020). Artificial intelligence distinguishes COVID-19 from community acquired pneumonia on chest CT. *Radiology, 296*(2), E65–E71.
10. López-Medina, E., López, P., Hurtado, I. C., Dávalos, D. M., Ramirez, O., Martínez, E., Díazgranados, J. A., Oñate, J. M., Chavarriaga, H., Herrera, S., Parra, B., Libreros, G., Jaramillo, R., Avendaño, A. C., Toro, D. F., Torres, M., Lesmes, M. C., Rios, C. A., & Caicedo, I. (2021). Effect of ivermectin on time to resolution of symptoms among adults with mild COVID-19: A randomized clinical trial. *JAMA, 325*(14), 1426-1435.
11. Mehta, P., McAuley, D. F., Brown, M., Sanchez, E., Tattersall, R. S. & Manson, J. J. (2020). COVID-19: Consider cytokine storm syndromes and immunosuppression. *The Lancet, 395*(10229), 1033–1034.
12. Mughees, M., Chugh, H., Naqvi, S. H., & Wajid, S. (2021). COVID-19 threat to the world: Current and possible diagnostic/treatment strategies. *Critical Reviews in Biomedical Engineering, 49*(1), 1-12.
13. Nalbandian, A., Sehgal, K., Gupta, A., Madhavan, M. V., McGroder, C., Stevens, J. S., Cook, J. R., Nordvig, A. S., Shalev, D., Sehrawat, T. S., Wan, E. Y. (2021). Post-acute COVID-19 syndrome. *Nature Medicine, 27*(4), 601–615.
14. RECOVERY Collaborative Group. (2020). Effect of hydroxychloroquine in hospitalized patients with Covid-19. *New England Journal of Medicine, 383*(21), 2030–2040.
15. Rubin, G. D., Ryerson, C. J., Haramati, L. B., Sverzellati, N., Kanne, J. P., Raoof, S., Schluger, N. W., Volpi, A., Yim, J. J., Martin, I. B. K., Anderson, D. J., Kong, C., Altes, T., Bush, A., Desai, S. R., Goldin, J., Goo, J. M., Humbert, M., Inoue, Y., Wells, A. U. (2020). The role of chest imaging in patient management during the COVID-19 pandemic: A multinational consensus statement from the Fleischner Society. *Radiology, 296*(1), 172-180.
16. Sethuraman, N., Jeremiah, S. S., & Ryo, A. (2020). Interpreting diagnostic tests for SARS-CoV-2. *JAMA, 323*(22), 2249–2251.
17. Sharma, A., Kontodimas, K. & Bosmann, M. (2021). Nanomedicine: A diagnostic and therapeutic approach to COVID-19. *Frontiers in Medicine, 8*, Article 648005.
18. So, A. D., & Woo, J. (2020). Reserving coronavirus disease 2019 vaccines for global access: Cross sectional analysis. *BMJ, 371*, Article m4750.
19. Watson, J., Whiting, P. F., & Brush, J. E. (2020). Interpreting a covid-19 test result. *BMJ, 369*, Article m1808.
20. World Health Organization. (2020). *Diagnostic testing for SARS-CoV-2: Interim guidance, 11 September 2020*.

***Corresponding Author:** Naina Srivastava