Annals of Medical and Health Research
An International Journal
OPEN ACCESS
Review Article
Check for updates

Established Norms of Covid'19 Management During the Recovery and Stabilization Phase: Perspectives on The Efficiency of Nanotechnology

S. Sheeba*[1], M. Murugan[1], A. S. Suman Sankar[1] and U. T. Karthika[2]

[1]*Department of Organon of Medicine, Sarada Krishna Homoeopathic Medical College, Tamil Nadu M.G.R. Medical University, Chennai, India*
[2]*Homoeopathic Physician, Trivandrum India*

Corresponding author: **S Sheeba** | E-mail: **sheeba.syduu@gmail.com**

Citation: S. Sheeba, M. Murugan, A. S. Suman Sankar and U. T. Karthika (2025). Established Norms of Covid'19 Management During the Recovery and Stabilization Phase: Perspectives on The Efficiency of Nanotechnology. *Annals of Medical and Health Research: An International Journal.*
DOI: https://doi.org/10.51470/ARMHR.2025.4.2.09

Received 14 August 2025 | Revised 11 September 2025 | Accepted 16 October 2025 | Available Online November 20 2025

Abstract
Coronavirus disease 2019 (COVID-19), caused by severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2), emerged as a global public health emergency. Despite major advances in medical science, the rapid spread of the disease highlighted the need for improved therapeutic and preventive strategies. Researchers across the world have explored innovative technologies to support diagnosis, treatment, and vaccine development. Nanotechnology has recently gained attention as a promising approach in biomedical research. Nano medicine offers advantages such as targeted drug delivery, improved therapeutic efficiency, and enhanced vaccine responses. The present review discusses the role of nanotechnology in the management of COVID-19, including antiviral activity of nanoparticles, nanoparticle-based diagnostics, vaccine delivery systems, and preventive applications. The opportunities and limitations of Nano medicine in addressing viral infections are also discussed.

Keywords: *COVID-19, Nano medicine, Nanoparticles, Pandemic, Viral infections.*

Introduction
Coronavirus disease 2019 (COVID-19) is caused by the virus SARS-CoV-2 and was first reported in China in late 2019. [1] The infection rapidly spread worldwide and was declared a global health emergency. [2] The pandemic created an urgent need for effective diagnostic techniques, therapeutic approaches, and preventive strategies. Traditional treatment methods alone have limitations in managing rapidly spreading viral infections. [3] As a result, advanced technologies such as nanotechnology are increasingly explored for their potential medical applications. [4] Nano medicine involves the use of nanoscale materials for diagnosis, drug delivery, and therapeutic interventions. These materials can improve drug stability, enhance immune responses, and enable targeted delivery of therapeutic agents. [5] Such advantages make nanotechnology a promising field for improving the management of COVID-19 and other viral diseases. [6].

Edifice of infection
Coronaviruses are enveloped viruses containing a positive-sense single-stranded RNA genome. Their genomes are among the largest found in RNA viruses. [7] The viral genome contains two major regions at the 5′ and 3′ ends. The 5′ region encodes proteins responsible for viral replication and transcription. [8] The 3′ region encodes structural proteins including the spike (S), membrane (M), nucleo capsid (N), envelope (E), and hemagglutinin-esterase (HE) proteins. [9] The spike protein facilitates attachment of the virus to host cell receptors and enables fusion with host cell membranes. The nucleo capsid protein binds with viral RNA and assists in viral replication and assembly. [10] The membrane protein determines the structure of the viral envelope, while the envelope protein participates in viral assembly and release. [5] The hemagglutinin-esterase protein contributes to host cell receptor binding and viral entry.

Method of spread
COVID-19 spreads primarily through respiratory droplets and close human contact. [11] Transmission may occur when infected individuals cough, sneeze, speak, or breathe, releasing virus-containing droplets that can enter the mouth, nose, or eyes of nearby individuals. Aerosol transmission may also occur in poorly ventilated environments. [6] Contaminated surfaces can contribute to indirect transmission when individuals touch infected surfaces and then touch mucous membranes. Common clinical manifestations include fever, cough, fatigue, shortness of breath, loss of taste or smell, headache, and gastrointestinal symptoms. [12]

Structures intricate in COVID-19

SARS-CoV-2 enters host cells by binding to angiotensin-converting enzyme 2 (ACE2) receptors located on the surface of many human cells. These receptors are highly expressed in the respiratory tract, particularly in alveolar cells of the lungs. Consequently, the respiratory system is the primary target of infection, which may lead to pneumonia and acute respiratory distress syndrome (ARDS). [7] The virus can also affect other organs such as the heart, liver, kidneys, and central nervous system due to the presence of ACE2 receptors in these tissues. [13] Severe infection may trigger an exaggerated immune response known as a cytokine storm, characterized by elevated inflammatory mediators such as interleukins and tumour necrosis factor, which can lead to multi-organ dysfunction. [14]

Role of Nano medicine in Viral Infection Management

Nano medicine refers to the application of nanotechnology in medical diagnosis and therapy. Nanoparticles can serve as carriers for drugs, vaccines, and diagnostic agents. [8] Their small size allows them to penetrate biological barriers and deliver therapeutic molecules directly to target tissues. [15] In respiratory infections such as COVID-19, nanoparticle-based drug delivery systems may enhance drug concentration in the lungs and improve treatment outcomes. Nano carriers also allow controlled release of medications and reduce systemic side effects. [16]

Nanoparticle-Mediated Antiviral Activity

Various nanoparticles demonstrate antiviral properties. Silver nanoparticles, gold nanoparticles, and quantum dots have been investigated for their ability to inhibit viral attachment, entry, and replication. [17] These particles can interact with viral surface proteins and block their ability to bind with host cells. [9] Nanoparticle-based drug delivery systems can also improve the therapeutic efficacy of antiviral medications while minimizing toxicity.

Nanoparticle Biosensors for COVID-19 Diagnosis

Nanotechnology has contributed to the development of rapid diagnostic tools for detecting SARS-CoV-2. [18] Nanoparticle-based biosensors can detect viral nucleic acids, antigens, or antibodies with high sensitivity and specificity. [10] For example, graphene-based biosensors and nanoparticle-assisted molecular detection systems have been explored for early identification of COVID-19 infections.

Nano Medicine-Assisted Vaccine Adjuvant Delivery

Nanoparticles are widely used as carriers and adjuvants in modern vaccine development. [19] They can protect antigens from degradation, enhance immune responses, and promote efficient antigen presentation. Lipid nanoparticles have played a crucial role in the delivery of mRNA vaccines developed for COVID-19. [11] Nanoparticle-based adjuvants may also improve vaccine efficacy in elderly and immunocompromised individuals. [20]

Preventive Strategies Using Nanotechnology

Nanotechnology has also been applied in preventive strategies. Nanofiber-based face masks and protective equipment provide improved filtration efficiency and enhanced protection against viral particles. [21, 22] Nanomaterials with antimicrobial or hydrophobic properties can be incorporated into medical textiles and protective equipment to reduce viral contamination. [12]

Constraints in the Application of Nano medicine

Despite the promising potential of Nano medicine, several challenges remain. Large-scale production of nanoparticles can be complex and expensive. [23] Safety concerns regarding long-term exposure, toxicity, and environmental effects also require careful evaluation. Further research is necessary to ensure the safe and effective application of nanotechnology in clinical practice. [13]

Conclusion

Nanotechnology offers promising opportunities for improving the diagnosis, treatment, and prevention of COVID-19. Nanoparticle-based drug delivery systems, biosensors, and vaccine platforms have demonstrated significant potential in addressing challenges associated with viral infections. [15] However, further research and large-scale clinical studies are required to optimize these technologies and ensure their safety and effectiveness. [24] Nano medicine may play a crucial role in the future management of emerging infectious diseases.

References

1. Nano medicine: a diagnostic and therapeutic approach to COVID-19. Frontiers in Medicine. 2021 Jun 4; 8:648005.
2. Consequences of COVID-19: A wide-ranging on efficacious action of homoeopathic medicines with stratagems tool aids: A literature research. International Journal of Homoeopathic Sciences, 7(4), 460–462. https://doi.org/10.33545/26164485.2023.v7.i4g.10122
3. Testing the nanoparticle-allosteric cross-adaptation-sensitization model for homeopathic remedy effects. Homeopathy. 2013 Jan;102(1):66-81., DOI: 10.1016/j.homp.2012.10.005., PMID: 23290882; PMCID: PMC3539158
4. Homeopathy emerging as Nano medicine. International Journal of High Dilution Research, 2011, 10.
5. An evaluation of Avogadro's number in the light of HRTEM and EDS study of high dilutions of Ferrum metallicum6, 30, 200, 1M, 10M and 50Mc. Int. J High Dilution Res. 2015;14(3): 3-9
6. Covid-19 and homeopathy: Systematic review and meta-analysis of clinical outcomes. Journal of Natural & Ayurvedic Medicine, 8(4), 000453. https://doi.org/10.23880/jonam-16000453
7. A review of Basic Research on Homoeopathy from a physicist's point of view. Indian Journal of Research in Homoeopathy. 2015; 9:141-51.
8. Recent Advances in Nanoparticle Research in Homeopathy. Homeopathy 4 Everyone. 2015, 12.

9. Metal nanoparticle induced hermetic activation: a novel mechanism of homeopathic medicines. Homeopathy. 106(3): 135-144.
10. Innovative advances in homeopathy: Based on nano particles exploration. Nano medicine & Nanotechnology Open Access, 9(4), 1–5. https://doi.org/10.23880/nnoa-160003333
11. Origin, transmission, diagnosis and management of coronavirus disease 2019 (COVID-19). Postgraduate medical journal. 2020 Dec;96(1142):753-8.
12. Main symptoms in patients presenting in the COVID-19 period. Scottish medical journal. 2020 Nov;65(4):127-32.
13. Homoeopathic Management of Migrating Poly-Arthritis: A Case Study. Indian Journal of Psychology, 118, 2023. ISSN: 0019-5553.
14. Nano medicine to deliver biological macromolecules for treating COVID-19. Vaccine. 2022 Jun 23;40(29):3931-41.
15. Nano medicine for COVID-19: the role of nanotechnology in the treatment and diagnosis of COVID-19. Emergent materials. 2021 Feb;4(1):75-99.
16. The potential role of Nano medicine on COVID-19 therapeutics. Therapeutic Delivery. 2020 Jul 1;11(7):411-4.
17. A study to parallel the anxiety levels of subjects with possessing homoeopathic remedy Arsenicum album 30 as a COVID-19 preventive and with devoid off. i-manager's Journal on Life Sciences. 2025;4(1):26-30. doi:10.26634/jls.4.1.2209.
18. Lipid-based nanoparticles in the clinic and clinical trials: from cancer Nano medicine to COVID-19 vaccines. Vaccines. 2021 Apr 8;9(4):359.
19. Origin, transmission, diagnosis and management of COVID-19. Postgraduate Medical Journal. 2020.
20. Nanotechnology for COVID-19: therapeutics and vaccine research. ACS Nano. 2020;14(7):7760-7782.
21. Nano medicine for delivery of biological macromolecules in COVID-19 therapy. Vaccine. 2022.
22. Toward nanotechnology-enabled approaches against the COVID-19 pandemic. Nature Nanotechnology. 2020; 15:936-946.
23. Cytokine storm in COVID-19: immuno pathological mechanisms and therapy. International Journal of Molecular Sciences. 2020; 21:4278.
24. COVID-19 vaccine development and nanotechnology. ACS Nano. 2020;14(10):12388-12408.