89

NANOMEDICINE-AN UNEXPLORED THERAPEUTIC REALM AGAINST COVID-19.

Niloy Chatterjee [a,b] and Pubali Dhar [a,b*]

[a] Laboratory of Food Science and Technology, Food and Nutrition division, University of Calcutta, 20B Judges Court Road. Alipore, Kolkata 700027, West Bengal, India.

[b] Centre for Research in Nanoscience & Nanotechnology, University of Calcutta, JD 2, Sector III, Salt Lake City, Kolkata 700 098, West Bengal, India

Nanotechnology in medicine is going to have a major impact on the survival of the human race- **Bernard Marcus.**

Nanomedicine

What? The application of nanotechnology to achieve innovation in healthcare.

Basis-Unique properties developed by a material at its nanometric scale (10^{-9} m).

Phenomenal alteration of physical, chemical or biological properties from bulk counterparts.

Nanometric size is also the scale of many biological mechanisms in the human body.

High S/V ratio and surface functionalisation so surface properties becomes an intrinsic parameter.

Has potential to enable early detection and prevention and to drastically improve diagnosis, treatment and follow-up of many diseases.

Fields of Impact: Personalized and targeted medicine, Diagnostics, Medical Imaging, Nanotherapeutics, Vaccines, Functionalisation of Biomaterials and regenerative medicine.

Technologies: Raw & Nanostructured materials, Nanopores, cell simulations and Diagnostics, Diagnostic tools, Intracellular devices, Molecular medicine, Nanorobotics, Synthetic nanodevices, Drug delivery, Nanotherapeutics, Bio-robotics, BioMEMS, surface control, Artificial binding, Enzyme control etc.

CoVID-19

- An infectious disease caused by a newly discovered coronavirus (SARS CoV-2).
- SARS CoV-2 belongs to a (+)ss RNA family of viruses that infect animals and humans, and is classified as β-CoV.
- Named for its crown-like surface projections (corona) of spike proteins
- SARS-CoV-2 has been reported to have <80.0% similarity with SARS genome and 50.0% similarity with MERS, it presents higher transmission and infection rates, but a low fatality percentage.
- The reproductive number (R_0) of SARS-CoV-2 is estimated to be 2.2.
- SARS-CoV-2 is transmitted in the community, due to the less severe symptoms.
- The high R_0 accounts for the large number of asymptomatic and subclinical cases, as well as lead to the great pandemic potential of CoVID-19.

Nanomedicine and CoVID-19

- An infectious disease caused by a newly discovered coronavirus (SARS CoV-2).
- Its application in viral diseases is underexplored and underused, as observed in the SARS-CoV-2 pandemic.
- Nanostructured systems can impact diagnosis, since they can improve the detection, sensitivity and increase the signal amplification specificity in PCR analysis; and prophylaxis as adjuvants for vaccines, as well as therapeutics for COVID-19 through the targeting of antiviral drugs.
- Nanoparticles may play an important role at different stages of COVID-19 pathogenesis owing to their inhibition potential.
- Nano-encapsulated drugs may be more efficient in activating intracellular mechanisms to cause irreversible damage to viruses and inhibition of viral transcription, translation and replication.

Challenges & Limitations

Safe translation of NPs from laboratory innovation to the clinic is highly challenging.

High mutation rate and the consequent genetic diversity of SARS CoV-2.

Absence of enough therapeutic targets, which can be easily targeted without affecting host cells.

Scaling up of NP production is very challenging.

More investment required in translation of bench-top research to clinical practice.

SARS-CoV-2 as an emerging pathogen has not enough animal models.

Each virus behaves differently from one host to another, and host response to SARS-CoV-2 is still under study.

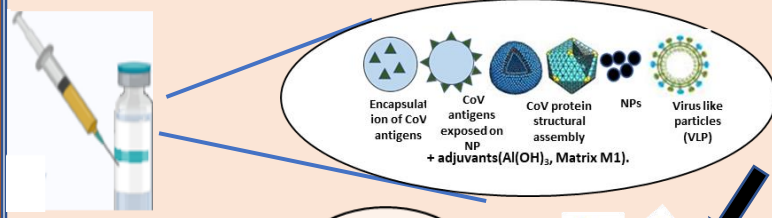
Future prospects:

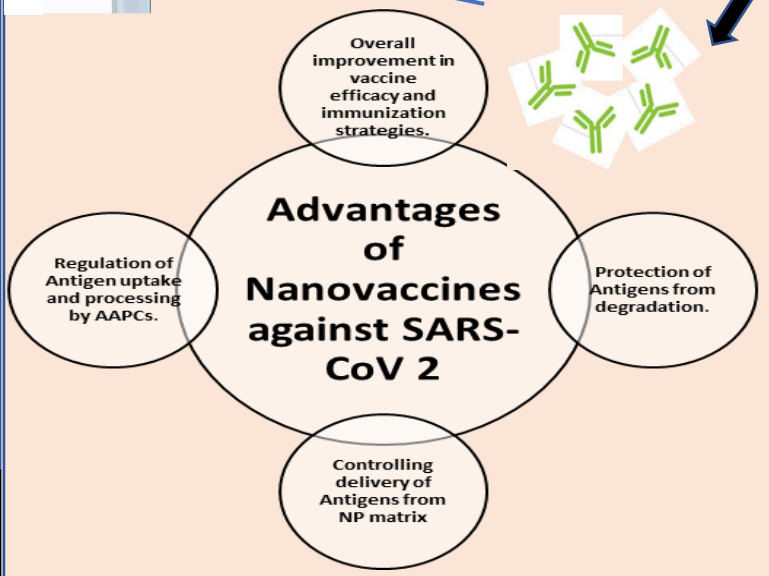
Complete understanding of virus virulence and transmission is still unavailable.

Regulation of various Nanomedicine needs to be transparent and fast track progress of commercialisation required.

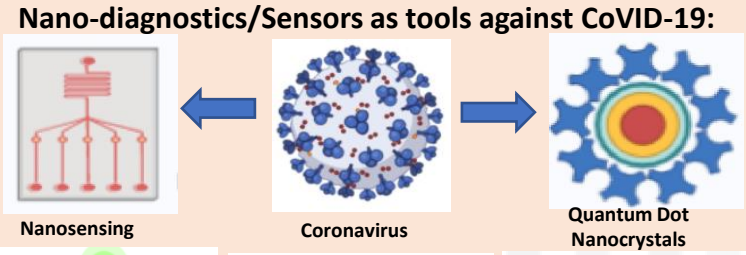
Drug and vaccine studies should be complementary so that Pandemic can be fought efficiently in future.

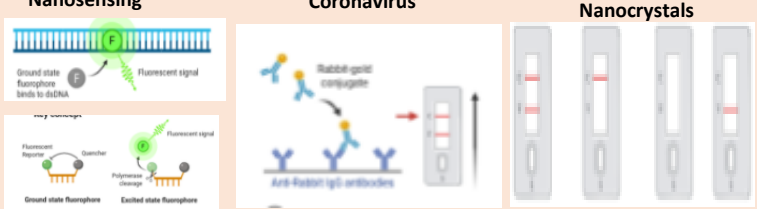
Nano-vaccines against CoVID-19:





Nano-diagnostics/Sensors as tools against CoVID-19:

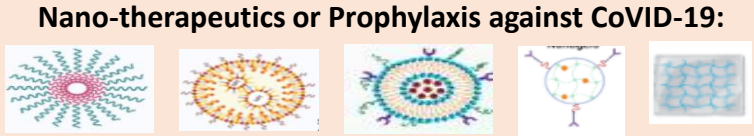




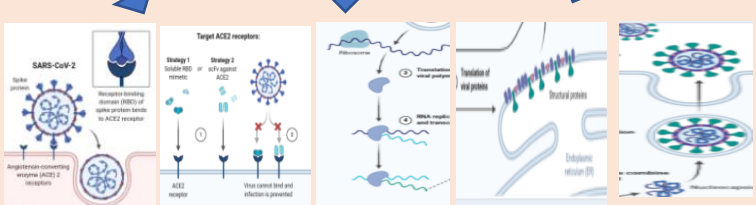
Increase in sensitivity, Robust, Less time consuming, Reproducible, Early detection

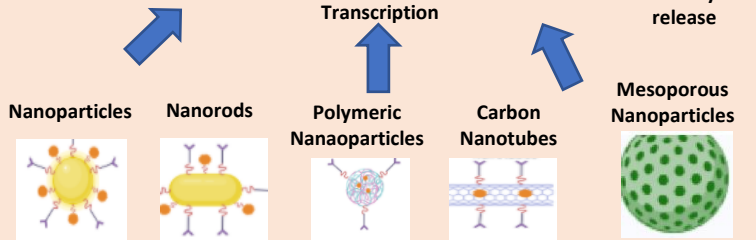
Result Amplification, Fast, Sensible, Less False Positive/Negative, Accurate Results

Nano-therapeutics or Prophylaxis against CoVID-19:



Drug delivery Nanosystems





References: Abd Ellah, Noura H., et al. "Nanomedicine as a promising approach for diagnosis, treatment and prophylaxis against COVID-19." *Nanomedicine* 0 (2020). Chauhan, Gaurav, et al. "Nanotechnology for COVID-19: Therapeutics and Vaccine Research." ACS nano