

**KENDRIYA VIDYALAYA, BALLYGUNGE**

**REPORT**

**CSIR-CECRI LIVE WEBINAR LECTURE SERIES on ELECTROCHEMICAL SCIENCE  
AND TECHNOLOGY (26<sup>th</sup> Aug 2020, 2pm)**

**TOPIC: DELINEATION OF INFECTIOUS DISEASE PROFILE: ROLE OF  
ELECTROCHEMICAL IMMUNOSENSORS**

**TALK BY Dr. V. MURUGAN**

**NUMBER OF STUDENTS REGISTERED & ATTENDED-25**

**TEACHER COORDINATOR- SABITABRATA MANDAL,PGT(BIO)**

**-POOJA DEVI PGT(CHEM)**

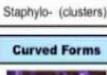
**STUDENT COORDINATOR- ANANYA PAUL XIIB**

### **HIGHLIGHTS**

- 1) OVERVIEW ON TYPES OF BACTERIAL AND VIRAL INFECTION.
- 2) BASIC DIFFERENCE BETWEEN BACTERIA AND VIRUS.
- 3) CONVENTIONAL ASSAY OF INFECTIOUS DISEASE.
- 4) ROLE OF ELECTROCHEMICAL IMMUNOSENSORS.

The meeting started at sharp 2pm. After a brief introduction he started to explain the real content.

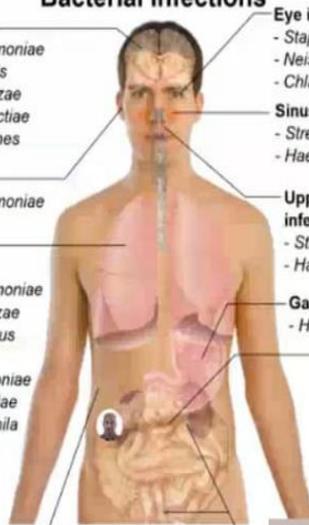
He started by giving a really interesting content on the bacteria( monera kingdom) and explained the impact of these tiny microbes in our surroundings and on us. The diseases that these living microorganisms can cause to us like pneumonia, typhoid etc.

Circular	Rod-shaped
 Diplo- (in pairs)	 Cocci bacilli (oval)
 Strepto- (in chains)	 Streptobacilli
 Staphylo- (clusters)	 Mycobacteria
Curved Forms	Other Shapes
 Vibrio (curved rod)	 Helicobacter (helical)
 Spirilla (coil)	 Corynebacter (club)
 Streptomyces	 Streptomyces

CRI Dr. V. V. V. V. V.

Source: <https://www.healthinfi.com/what-is-bacteria/>

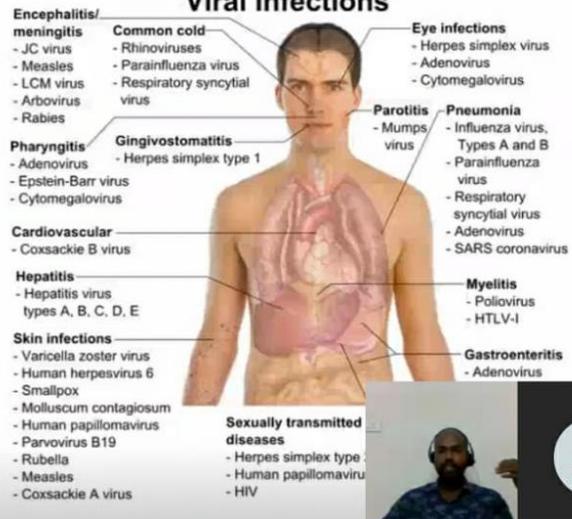
### Overview of Bacterial infections



- Bacterial meningitis**
  - *Streptococcus pneumoniae*
  - *Neisseria meningitidis*
  - *Haemophilus influenzae*
  - *Streptococcus agalactiae*
  - *Listeria monocytogenes*
- Otitis media**
  - *Streptococcus pneumoniae*
- Pneumonia**
  - Community-acquired:
    - *Streptococcus pneumoniae*
    - *Haemophilus influenzae*
    - *Staphylococcus aureus*
  - Atypical:
    - *Mycoplasma pneumoniae*
    - *Chlamydia pneumoniae*
    - *Legionella pneumophila*
  - Tuberculosis
    - *Mycobacterium tuberculosis*
- Eye infections**
  - *Staphylococcus aureus*
  - *Neisseria gonorrhoeae*
  - *Chlamydia trachomatis*
- Sinusitis**
  - *Streptococcus pneumoniae*
  - *Haemophilus influenzae*
- Upper respiratory tract infection**
  - *Streptococcus pyogenes*
  - *Haemophilus influenzae*
- Gastritis**
  - *Helicobacter pylori*
- Food poisoning**
  - *Campylobacter jejuni*
  - *Salmonella*
  - *Shigella*
  - *Clostridium*
  - *Staphylococcus aureus*
  - *Escherichia coli*
- Skin infections**
  - *Staphylococcus aureus*
  - *Streptococcus pyogenes*
  - *Pseudomonas aeruginosa*
- Sexually transmitted diseases**
  - *Chlamydia trachomatis*
  - *Neisseria gonorrhoeae*
  - *Treponema pallidum*
  - *Ureaplasma urealyticum*
  - *Haemophilus ducreyi*

Next he enlightened us with his great knowledge on the viruses and the diseases caused by them like the common flu, the STDs which are caused by virus, hepatitis etc and explained the mechanism how the virus hijack the cellular mechanism of the host cell and basically forces the host cell to function as a factory for the synthesis of new viruses.

## Overview of Viral infections



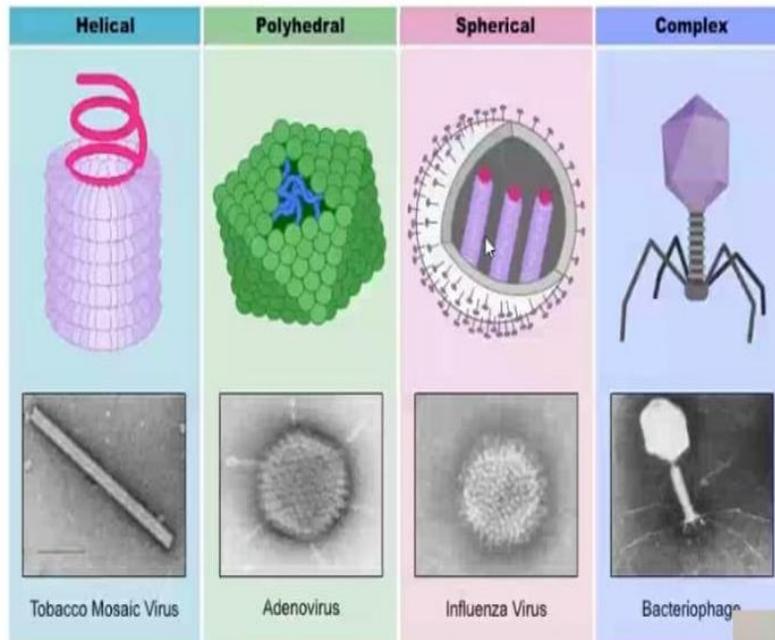
Most viruses have either RNA or DNA as their genetic material.

The nucleic acid may be single- or double-stranded.

The entire infectious virus particle, called a virion, consists of the nucleic acid and an outer shell of protein.

The simplest viruses contain only enough RNA or DNA to encode four proteins.

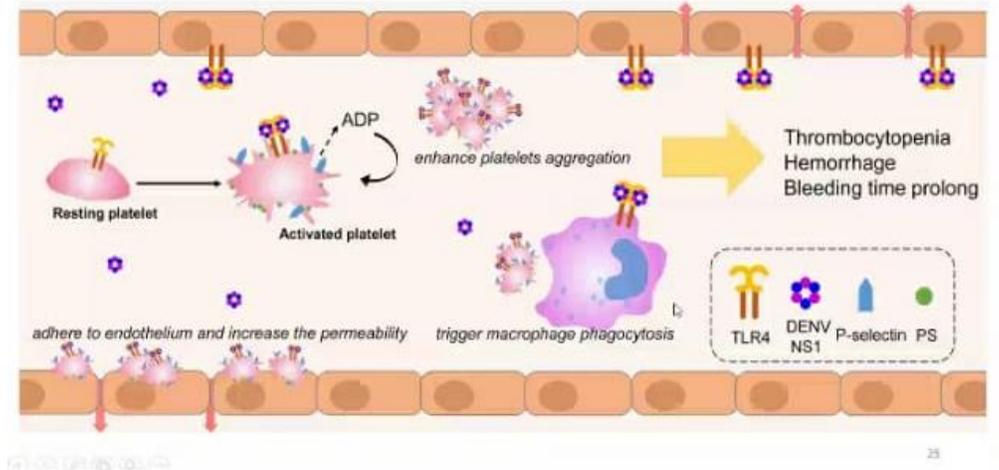
Dr. V. Murugan  
Credit: Bruce Ruben



Viruses come in many shapes and sizes, and only replicate when inside living cells. A non-enveloped virus, meaning it has no protective coating. A retrovirus is an example of a virus, making it more resilient and causes higher tendency of infection or diseases.

Dr. V. Murugan

## Dengue Viral Infection: NS1 Protein



He also made us understand the difference between the two major type of viruses i.e. the adino virus and the retro virus.

- Adino virus: The non capsulated virus. These virus are more prone to destruction hence are easily destroyed.
- Retro virus: These are the viruses with capsules/ envelope around them. As they are protected by the covering they are more virulent in nature and are hard to cure eg. SARS

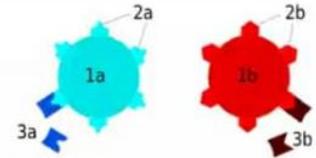
Next he clarified the basic difference between the bacterial and the viral infections that will help us to identify and distinguish the type of disorders caused by these two main pathogenic microorganisms.

Viruses	Bacteria
I. They are very small.	They are larger in size as compared to viruses.
II. Non-cellular.	Single-celled.
III. Have no metabolism of their own.	Have metabolism of their own.
IV. Taken no food by any method.	Take food by absorption.
V. Do not grow and do not divide.	Grow in size and divide to produce more bacteria.
VI. Command the host cell to produce virus.	They can reproduce by their own.
VII. Can be crystallised.	Cannot be crystallised.
VIII. All produce diseases in man, animals or plants.	Some are harmless, some are useful and some are disease causing.

Now one of the new and interesting yet useful information that we got today was about the “serotypes” or “serovars”

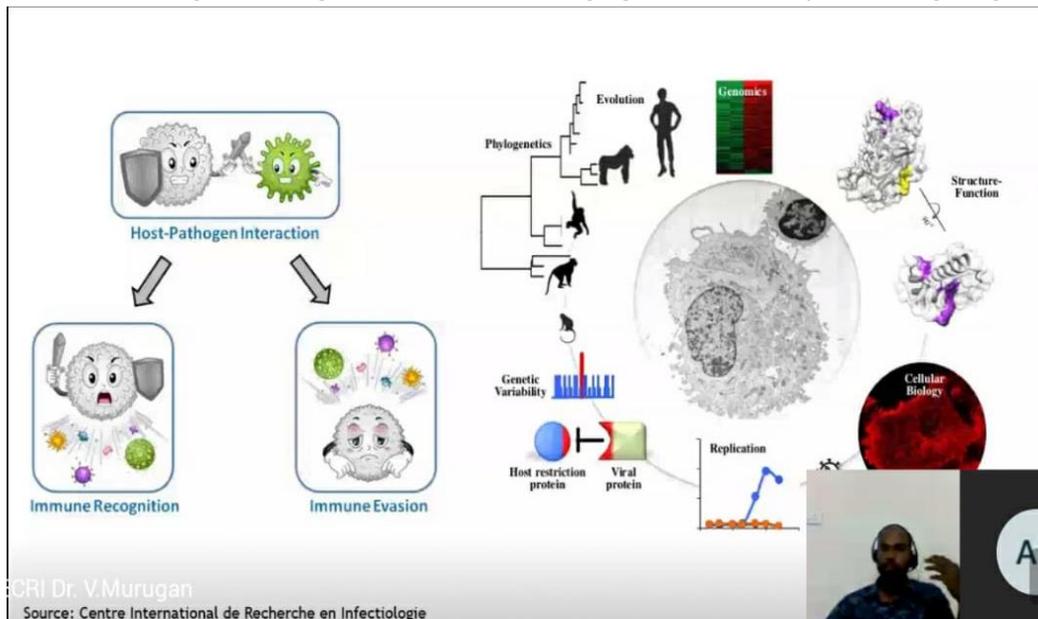
**Serotypes are basically two subspecies under a single strain, and was first identified by Rebecca Lancefield in 1933. Serotypes are groups within a single species of microorganisms, such as bacteria or viruses, which share distinctive surface structures.**

## Serotype or Serovar

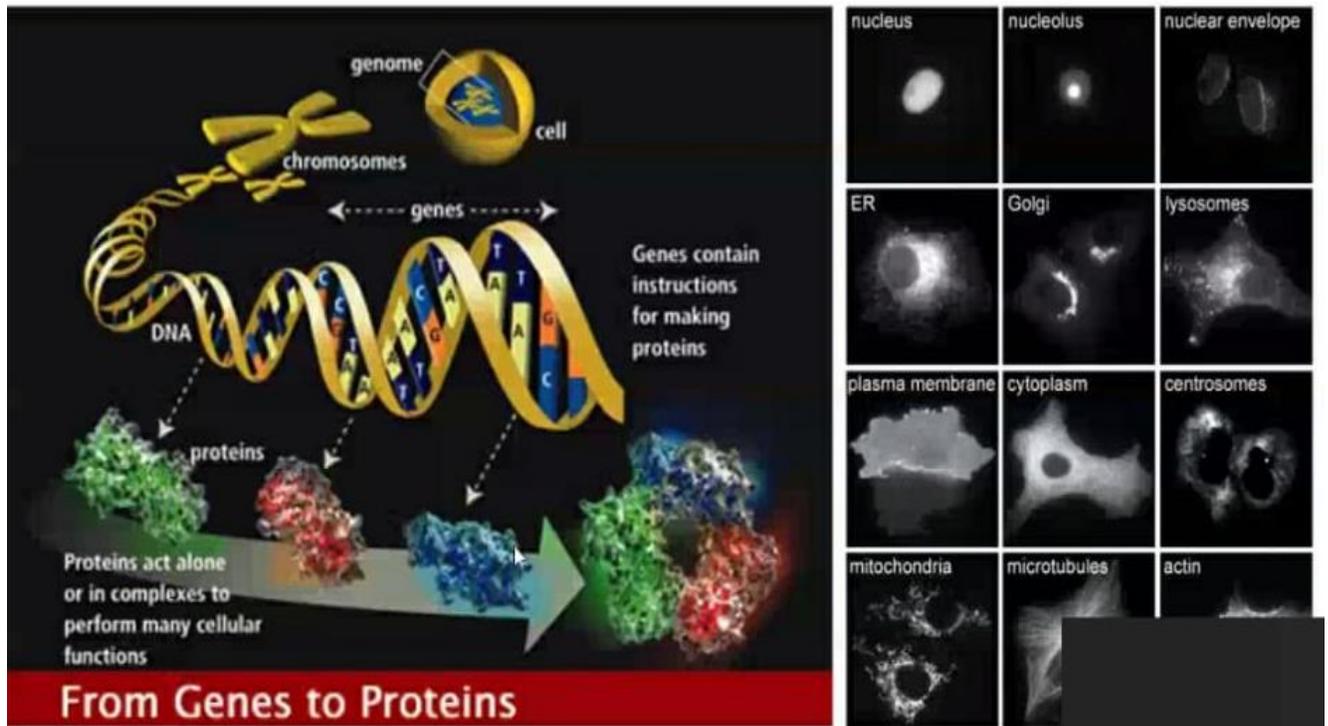


- A distinct variation within a species of bacteria or virus or among immune cells of different individuals.
- These are classified together based on their cell surface antigens, allowing the epidemiologic classification of organisms to the subspecies level.
- Group of serovars with common antigens is called a **serogroup** or sometimes *serocomplex*.
- Serotyping often plays an essential role in determining species and subspecies. The *Salmonella* genus of bacteria (2600 serotypes).
- *Vibrio cholerae* (200 serotypes) based on cell antigens. Only two of them have been observed to produce the potent enterotoxin: O1 and O139.
- Serotypes: American microbiologist Rebecca Lancefield

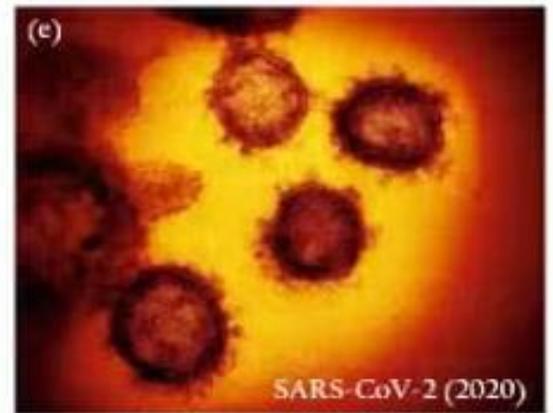
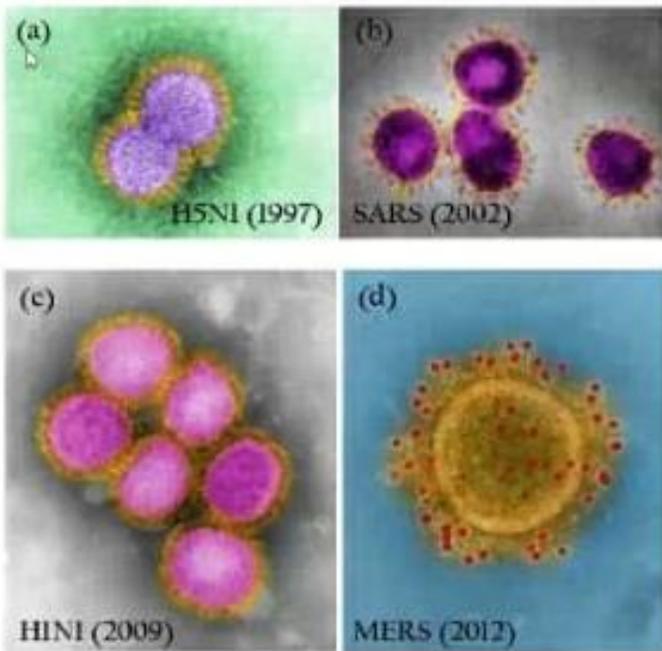
He also elucidated the means of dispersal of these harmful microorganisms and how they are effecting our immediate surroundings including us and how it is changing our immune system to fight against them!



With some original pictures the lecture was made very attractive, informative and engaging.

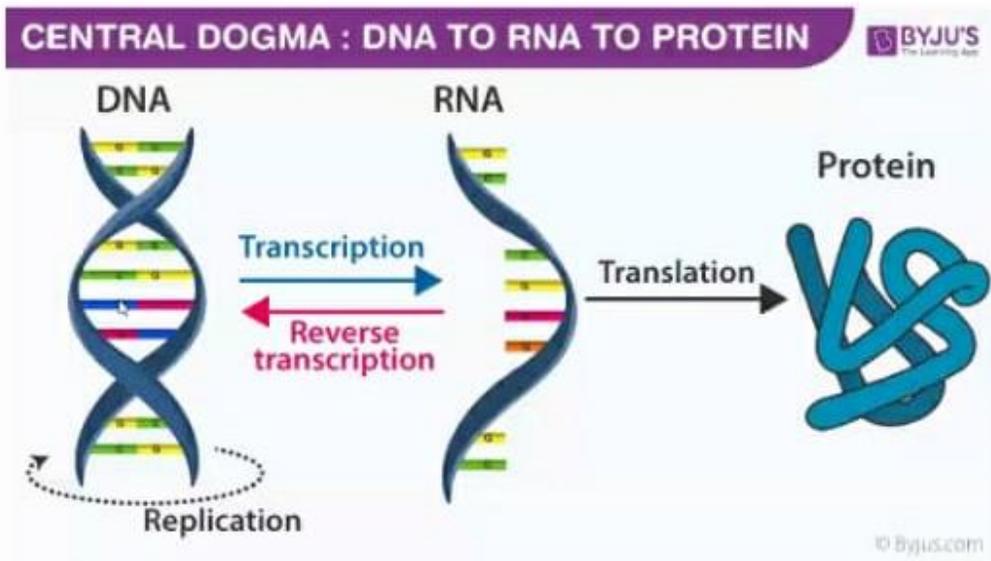


## Electron Micrographs of Virus Structures



Credit: Science Source (a); Getty/Callista Images (b,e); NIAID (d); NIAID-RML (e)

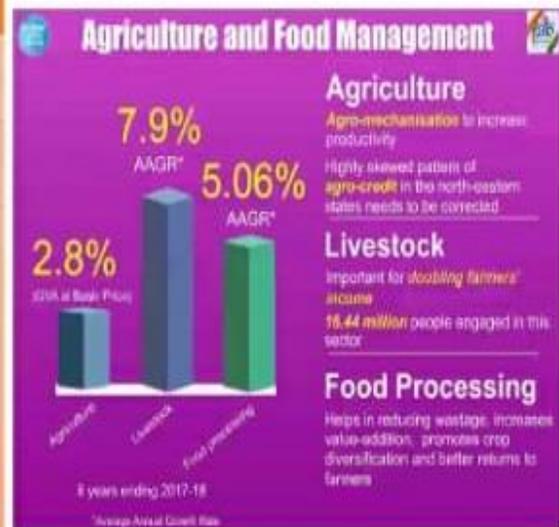
Source: K. Kostarelos, *Nat. Nanotechnol.* May 2020



For a better health we always try to eat healthy. Keeping that in mind he also explained us the importance of agriculture and food management and beautifully represented the data using graphs and charts.

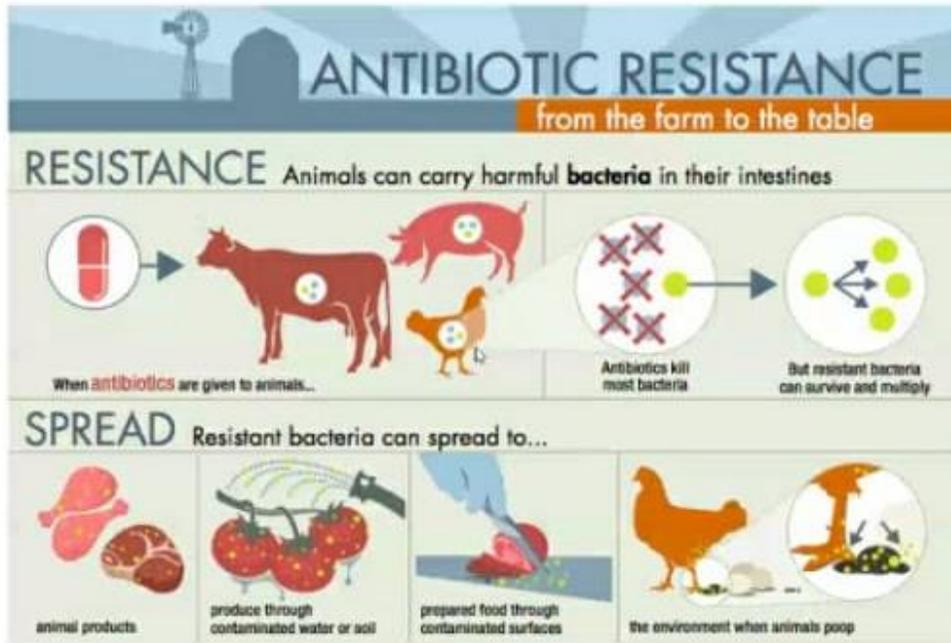
## Livestock population (2019 Livestock census)

Sl. No	Species	Number (In millions)	Ranking in the world population
01	Cattle	192.49	Second
02	Buffaloes	109.85	First
	Total (including Mithun and Yak)	302.79	First
03	Sheep	74.26	Third
04	Goats	148.88	Second
05	Pigs	9.06	-
06	Others	0.91	-
	Total livestock	535.78	
	Total poultry	851.81	Seventh
07	Duck	-	
08	Chicken	-	Fifth
09	Camel	0.25	Tenth



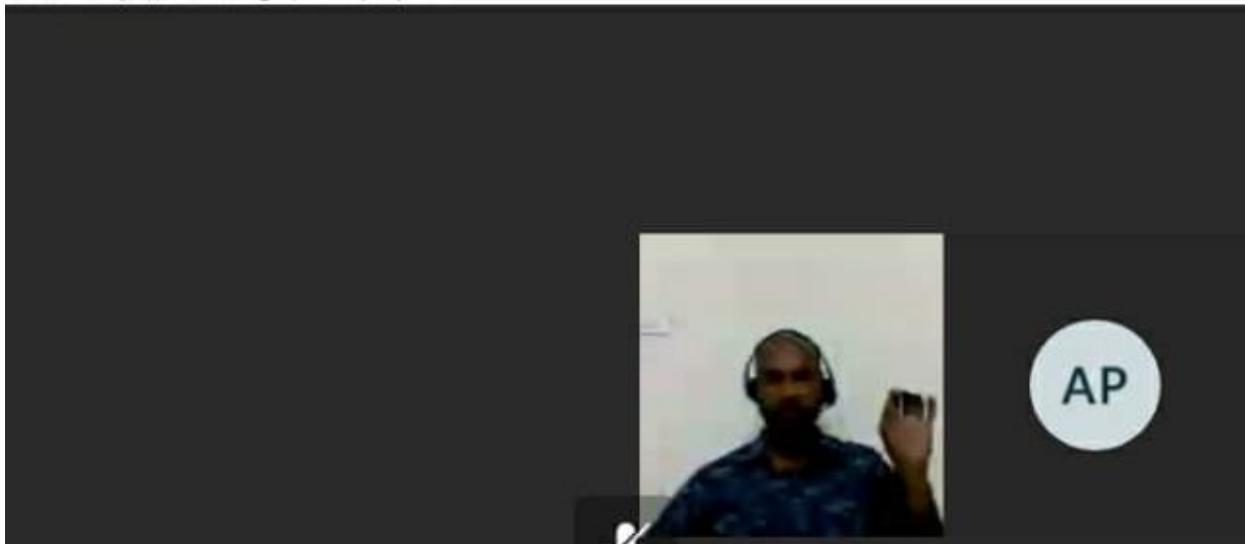
Source: <https://vikaspedia.in/agriculture/livestock/role-of-livestock-in-indian-economy>

One of the interesting question that was mention and explained by him was “ why the bat which carried the virus of SARS(COVID19) was not effected by the virus?”



Source: <https://www.cdc.gov/narms/faq.html>

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on answer to this he made us understand the importance receptor specificity of the binding proteins present on the surfaces of the virus, and how these spike proteins bind to the specific host cell to cause replication leading to infection and disease.

He also focused on how these organisms show high degree of mutation to change their shape/structure to combat with the environmental changes. He also explained how different animals, birds, insects etc act as a carrier /vector for these harmful pathogens(zoonotic diseases).

Apart from these there can be environmental transmission of bacteria, hospital transmission of pathogens which can be seen on a large scale in cases such as COVID19.



Then he explained a very important concept which is really useful in this time that how the assay is done for the confirmatory test of COVID 19 along with the structure of corona virus.

**Diagnostic Workflow: Confirmatory Assay: Real-Time RT-PCR**

❑ First line screening assay

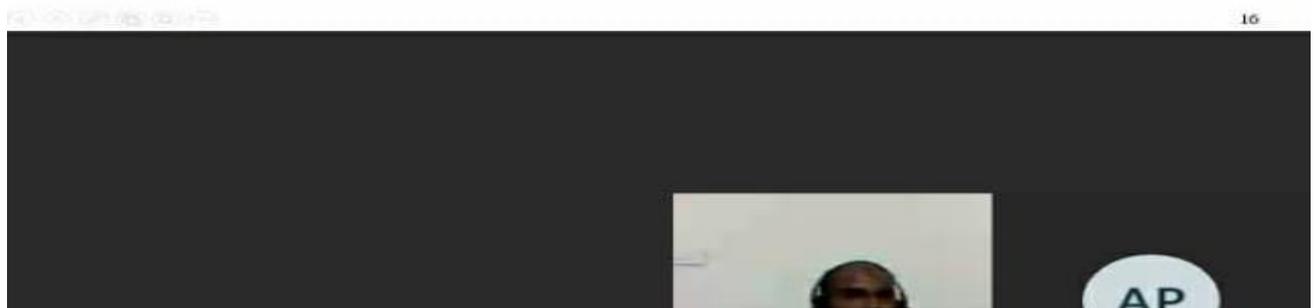
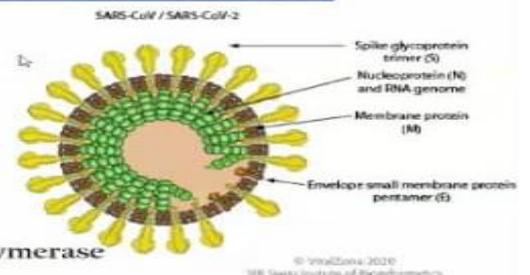
E gene assay: Envelope small membrane protein

❑ Confirmatory assay

RdRp gene assay: RNA-dependent RNA polymerase

❑ Additional confirmatory assay

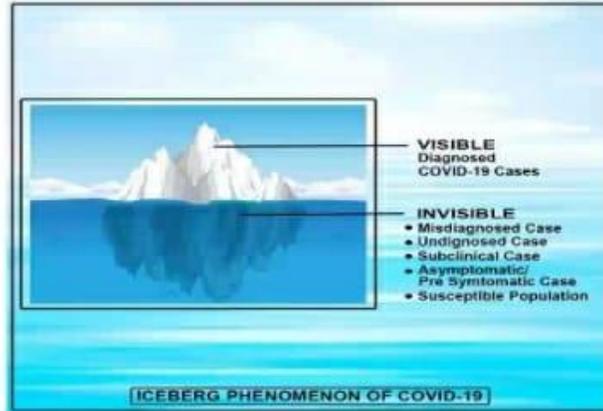
N gene assay: Nucleocapsid genes of SARS-COV-2



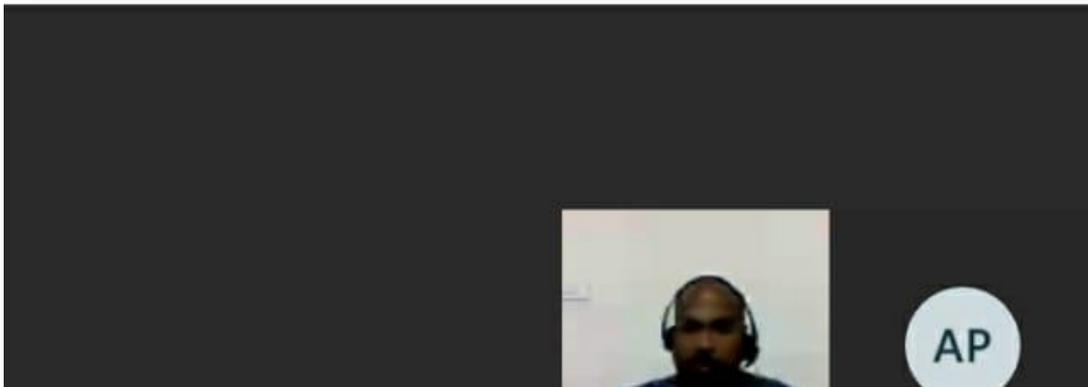
He also explained the iceberg phenomena for the case of COVID19

## Perspective from Pandemic Situation

- ✓ Immunomodulators in dietary source
  - Nutraceuticals,
  - Phytochemical Values,...
- ✓ Understating of Psychopathology
  - Endocrine function
- ✓ Inter-/trans-disciplinary nature of R&D
  - Engineering, Basic Science & Practical need



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Moving on he gave us a broad view about the growing health care market globally and how we can make the future of the medical sector better for our own country as well as for the humanity as a whole with the use of new technologically advanced devices and processes.

He gave us a brief idea about electrochemical sensors and how they work, about how immunomodulators can be beneficially used, the effect of phytochemicals in our diet and the importance of psychopathological balance in our life.



## ELECTRODES & BIOSENSOR RESEARCH



- Fabrication cost
- Limited field use

### Point-of-Care Diagnostics



- Response time: < 1 min
- Flexible matrix
- Multiplexed detection
- Reduced assay cost



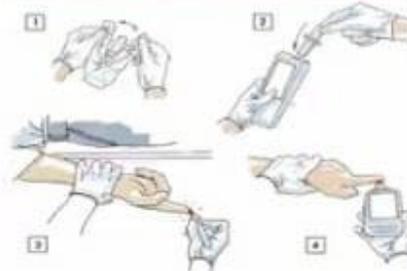
RSC Adv., 2018, 8, 34012

Wang et al. Chem. Rev. 108 (2008) 814

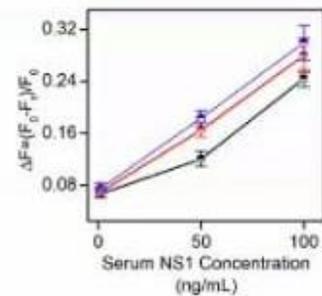
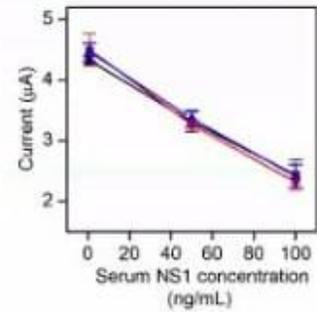
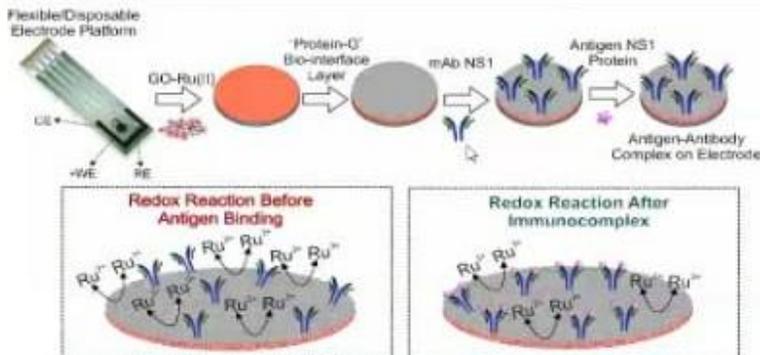
## Patient-Side Clinical Diagnostics: A Potential need?



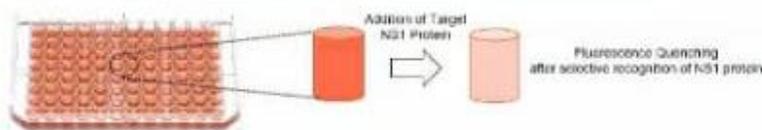
- ❖ Rapid detection of clinical abnormalities
- ❖ Improve health care treatments
- ❖ Point-of-care-testing (POCT)
- ❖ Low cost, easy integration, high sensitivity & good selectivity



### Electrochemical Method of Immunosensing of NS1 Protein



### Optical Method of Immunosensing of NS1 Protein



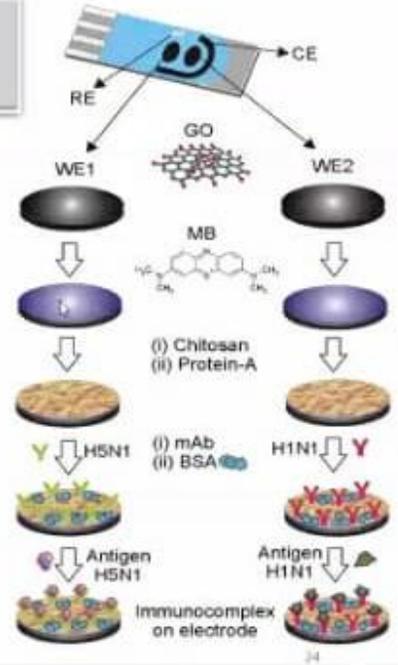
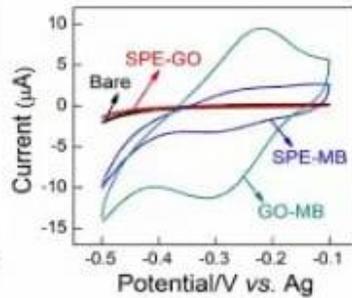
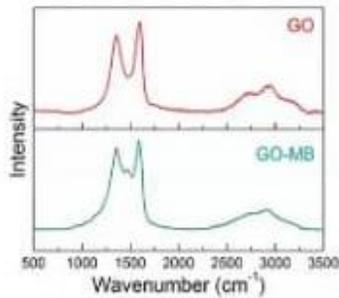
GO-Ru(II)-modified with biotinylated layer & monoclonal antibodies of NS1

He also shared his own work with us which was really inspiring!

Veerapandian et al., Dual immunosensor-Methylene blue-electroadsorbed GO: Influenza A virus antigen. *Talanta* (2016) (Cited 30)

Canadian Public Health Data

- ❑ 12,200 hospitalizations seasonal flu
- ❑ Average 3500 deaths/year [Flu]
- ❑ 5309.9 million-Minnesota Poultry Outbreak Loss



*Talanta* 155 (2016) 250



Last but not the least he ended the meeting by showing the acknowledgement and answering our questions informative answers. It was a very helpful session.