ISASINDIA Newsletter

Vol 21, No. 1 *January 2021*

From Editor Desk

Happy New Year 2021

I welcome you on the first issue of the year. Heartiest congratulations to Dr. Raghav Saran for publishing book " a of ATOM (for an inquisitive). Really wonderful and inspiring job accomplished by Dr. Saran. The book has been reviewed by Yammun Singh, University of Hyderabad. All ISAS members will be highly benefited by the book. The book is available on amazon, donot hesitate to put order for buying book. Kerala Chapter has organised webinar series keeping in mind interest of students and research scholars. The webinar series was inaugurated by Dr K. L. Sebastian- Professor and Dean – Research , IIT , Palakkadon on 11th October 2020 and delivered a talk also. Three more talks were delivered by Dr. Mahesh Hariharan , Professor , IISER , Trivandrum, Dr. Reji Varghese , Professor , IISER, Dr. Vinesh Vijayan, IISER , Trivandrum. Prof. Dr. Subi Jacob George , *Shanti Swaroop Bhatnagar awardee 2020*,delivered a talk entitled "Towards Life like Dynamic Materials" on 9th November , 2020 . ISAS Nagpur Chapter also organised webinar lectures. Lectures were delivered by Dr. V.Balaram, Dr. N.L. Mishra. *Dr. , Kinshuk Dasgupta, Shanti Swaroop Bhatnagar awardee 2020 in chemistry*, from Bhabha Atomic Research Centre, delivered talk on "Carbon Nanotube to Bhabha Kavach" on 3rd November, 2020. Dr. Poduval, former Professor, Homi Bhabha National Institute and former Head, Immunology and Hyperthermia Section, BARC, Mumbai delivered talk on "Role of Natural Immunity and Vaccine in Management of Contagious Diseases " on December 19,2020. An article based on his lecture has been included in the news letter. Article " The science of COVID testing " complied by Dr. V. Nair presents nice informative on corona testing. CO_2 emission from industries is considered cause for global warming, thus is of environmental concern. An article is devoted for "Carbon dioxide Sequestration in Deep Saline Aquifer" by Dr. Pradeep Kumar. For the benefit of students artilce "Derivative Spectrophotometry" is written by Dr. Saran.

Happy Republic Day.

Dr. Pradeep Kumar
Chief Editor & Vice president ISAS

Message from ISAS President

****

Happy New Year 2021 to all Members of ISAS.

Happy to present this ISAS News Letter.

As part of ISAS Objective, to promote dissemination of various scientific information amongst its Members, and science enthusiasts, ISAS has been conducting, and continuing to conduct,

ISAS Webinars in which Experts on Various Scientific Topics Spoke, Continue to Speak, About their Scientific Findings, Observations, etc. This Issue of ISAS News Letter contains the Views Of Such Experts, reproduced for those who have missed the ISAS Webinar. Science for Human Welfare is evolved through exposures to all scientific information, development of right scientific temper, thereby developing an increased confidence in the reliability of science and scientific solutions. I convey my best wishes to all Members of ISAS, for a Happy, Healthy And Active Life for themselves and their families and friends.

(Dr. P.P. Chandrachoodan)

President ISAS, Mumbai

Special Remarks from ISAS Newsletter

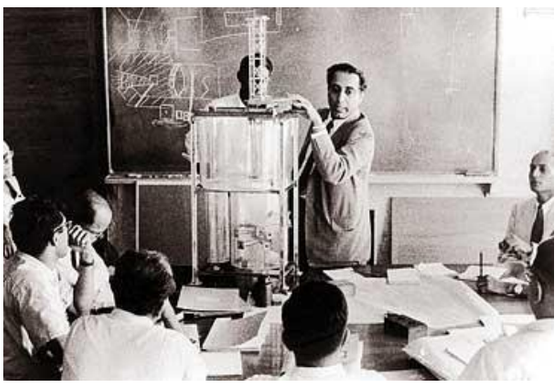
The opinions, views, statements and conclusions expressed in the various articles, included in this ISAS News Letter, are the sole responsibility of the auther(s) who are experts in the specific subjects covered by such articles. ISAS is only disseminating various scientific views of experts, in accordance with ISAS objectives.

Dr. Homi Jenhagir Bhabha

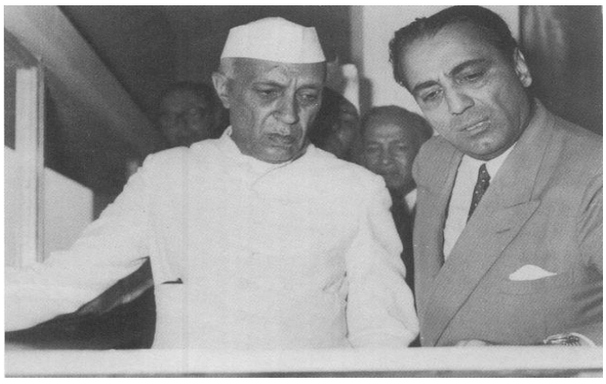
Father of Indian Nuclear Power Programme
(30 Oct, 1909- 24 Jan. 1966)

Homi Jehangir Bhabha, the main architect of Indian Atomic Energy programme, was born in a rich Parsi family on 30 October 1909 in Mumbai. He received his early education at Mumbai's Cathedral Grammar School and did his college in Elphinstone College. He went to Cambridge University, forced by his father and his uncle Dorabji Tata, who wanted him to get a degree in mechanical engineering so that on his return to India he can join the Tata Mills in Jamshedpur as a metallurgist. Bhabha's illustrious family background had a long tradition of learning and service to the country. The family, both on his father's and his mother's side was close to the house of Tatas, who had pioneered projects in the fields of metallurgy, power generation and science and engineering, in the early half of the twentieth century. The family imbibed a strong nationalistic spirit, under the influence of Mahatma Gandhi and the Nehru family. The family also had interests in fine arts, particularly Western classical music and painting, that aroused Bhabha's aesthetic sensibilities, and it remained a dominant influence in all the creative work he undertook during his life time. Bhabha, after completion of his engineering, switched over to physics. During the period 1930–39, Bhabha carried out outstanding original research relating to cosmic radiation. This earned him a Fellowship of the Royal Society in 1940, at the young age of 31. Bhabha returned to India in 1939, and had to stay back on account of the outbreak of the Second World War. He was selected to work at the Indian Institute of Science, Bangalore, where Sir C.V. Raman, India's first Nobel laureate in Science, was at the time Head of the Department of Physics. Initially appointed as a Reader, Bhabha was soon designated as Professor of Cosmic Ray Research. Bhabha's leadership of the atomic energy programme spanned 22 years, from 1944 till 1966. The Tata Institute of Fundamental Research was formally inaugurated in December 1945 in 'Kenilworth' building, which was Bhabha's ancestral home. In January 1966, Bhabha died in a plane crash near Mont Blanc while heading to Vienna, Austria, to attend a meeting of the International Atomic Energy Agency.

Bhabha in conversation with Niels Bohr -1960: physicists Albert Einstein, Hideki Yukawa,John Wheeler and Bhabha in conversation while walking through Marquand Park in Princeton, New Jersey.



Bhabha Explaining APSRA Reactor to AEET members-1955 Smt. Indira Gandhi inaugurating and Bbabha clapping



Pt Nehru, Shastri and Bhabha Bhabha in serious discussion on Nuclear Energy with Pt. Jawahr Lal Nehru Ist Prime Minister of India

a of ATOM (for an inquisitive)

BOOK REVIEW

Dr. Raghaw Saran
PhD, FICS, FIC,
Vice President, ISAS
LM ISAS, LM INCAS
Patron, UCC
Adjunct Professor, RCOEM
Senior Scientist (Former),
AMD/DAE

Author: Dr.Raghaw Saran, Publisher: Not mentioned, Distributor: Not mentioned, Year of publication: Not mentioned, ISBN: 978-1-63745-830-3, Price Rs. 215 (Paperback)

The world witnessed fullest power of the 'atom' on 6 and 9 August 1945 immediately after dropping of atomic bombs over the Japanese cities of Hiroshima and Nagasaki by America. Since then possession of 'atomic power' became a measure of power of any country! Consequently, a race was ignited amongst countries to acquire 'atomic power' to become superpower. This catastrophic event in Japan also simultaneously accentuated enormous curiosity in people's mind all over the world to know more and more about the 'atom'. Now it is amply visible that immensely ramifying applications of atom have emerged in high technology domains and other fields.

It is in the above background, book by Dr.Raghaw Saran is a welcome addition. The reason for publishing this book, as stated by the author, is to make all the information available on the atom at one place so that it is easy for the learners. Viewed in this context, overall, the author has certainly tried to achieve this goal. The book runs into 131 pages, printed in A-5 size, and narrated in nine chapters, 11 illustrations, and 4tables. Chapter 1 on 'Atomic models' outlines Rutherford's model; Bohr's model, including Spectral lines, Lyman series, Balmer series, Paschen series, and Pfund series; Bohr's orbit; Limitations of Bohr's model; Sommerfeld relativistic atom model; Vector atom model; and Reasons for failure of Bohr's model. A synoptic description of De Broglie principle; Heisenberg's uncertainty principle; Schrodinger wave equation; and Quantum mechanical model of atom is given in Chapter 2 on 'Wave equations'. Chapter 3 on 'Quantum numbers' provides a brief description of Orbital along with Orbital angular momentum, Shape of orbitals: s-orbital, p-orbital, d-orbital, and f-orbital; Energies of orbital; Shielding effect including Slater's rules; and Filling of orbitals in atom including Aufbau principle, Pauli's exclusion principle, and Hund's rule of maximum multiplicity. In Chapter 4 on 'Study of atom' Elements including Moseley's law, Long form of periodic table, and Nomenclature of elements with atomic number beyond 100 have been outlined. Chapter 5 on 'Electronic configuration of elements in the periodic table' deals with Electronic configuration in periods; Group-wise electronic configuration; Electronic configurations and type of elements including s, p, d, f blocks and their elements; Lanthanide contraction including its causes and effects; Actinides;

Geochemistry of uranium; Comparison between Lanthanides and actinides; and Metals, non-metals, and metalloids. Following this, Chapter 6 on 'Periodic trends in properties of elements' focuses on Atomic radius and ionic radius; Ionisation enthalpy; Electron gain enthalpy; Electronegativity including anomalous properties of second period element; Diagonal relationship in the periodic properties; and Inert pair effect in p-block elements. Afterwards, Chapter 7 on 'Stability of nuclei' provides an account of Stability; Salient features of the nuclear forces; Origin of the strong interaction; and Nuclear parameters including Nuclear mass, Nuclear radius, Nuclear density, Nuclear charge, Nuclear quantum states, and Mass defect. Succeeding Chapter 8 on 'Binding energy' covers aspects of Binding energy; Nuclear shell model; Liquid drop model; Natural radioactivity; Law of radioactive decay including Activity, Half-life, and Mean lifetime; Applications of radioactivity; and Radioactive dating. The book concludes with Chapter 9 on 'Nuclear reactions' and describes processes of spontaneous changes in the nucleus due to natural radioactivity and external bombarding particle; Q-value; Nuclear reaction cross-section, including Microscopic, Macroscopic, and Differential; Neutron-neutron induced reactions; Nuclear fission; Energy released during nuclear fission; Nuclear chain reaction; Controlled chain reaction; Critical mass and critical size; Uncontrolled chain reaction; Atom bomb; Nuclear energy; and Nuclear reactors. The other highlights of this chapter are Components of nuclear reactors, namely, Fuel, Moderators, Reflectors, Coolants, Control rods, Structural and cladding materials; and Reactor shielding. Furthermore, an outline of Types of nuclear reactors; Nuclear fusion; Nuclear fusion reaction in stars; Controlled thermonuclear reactions; and Fusion reactor has also been provided.

The book has some short comings of minor nature. It lacks a subject index and a list of selected readings for the interested readers to pursue further. Illustrations and tables do not have numbering and captions and their citations in text. 'Introduction' stands isolated from rest of the book matter. In several places in the text, the author has used the abbreviation 'etc.'. This should have been avoided and items involved specified. Many descriptions are too much squeezed, which otherwise needed little more space.

In conclusion, I think that the book provides a very useful synthesis on various aspects of 'Atom' including different applications, that have emerged over the years, linked with wonderful properties of atom. As such it is starting point for learners inquisitive to know about mysteries of atom. Those seeking in-depth information would, however, need to look somewhere else. Due to lack of information about name and address of publisher and distributor it may be little tedious for any individual to get own copy.

Yamuna Singh
Centre for Earth, Ocean and Atmospheric Sciences, Earth Science Building,
University of Hyderabad, Gachibowli, Hyderabad-500 046
yamunasingh1957@gmail.com

Report of the webinar series organized by ISAS – Kerala Chapter

October- November , 2020

ISAS Kerala Chapter had organized a webinar series for college as well as university students , research scholars and teachers during October – November, 2020. This webinar series was based on few selected topics of interest to students and researchers. The webinar series was inaugurated by Dr K L Sebastian- Professor and Dean – Research , IIT , Palakkadon October 11th and he delivered a talk on " The Strange and Beautiful World of Quantum Mechanics " in two sessions on 11th and 12th of October . Dr. P.P. Chandrachoodan , National President -ISAS gave an overall introduction to the webinar series being organized by ISAS – National and ISAS chapters.

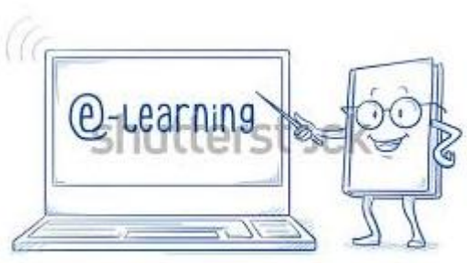
The second lecture in this series ,"A Glimpse of Molecular spectroscopy " was delivered by Dr.Mahesh Hariharan , Professor , IISER , Trivandrum on 17th& 18thOctober . Dr. V.R. Nair , Chairman , National Webinar Committee of ISAS inaugurated the program.

The third lecture on Applications of Spectroscopic techniques in organic chemistry was delivered by Dr. Reji Varghese , Professor , IISER on October 24th and November 3rd. Dr. N.K. Pillai , Former Chairman , ISAS-National inaugurated this program.

The fourth lecture in the series on "Introduction to statistical thermodynamics" was delivered by Dr. Vinesh Vijayan, IISER , Trivandrum on 7th& 8th November. Dr. R. Rajeev , former Head , Spectroscopy Division , VSSC inaugurated the program.

ISAS-Kerala Chapter and ISAS National Jointly organized a webinar on 9th November , 2020 to honour Prof. Dr. Subi Jacob George , **Shanti Swaroop Bhatnagar awardee 2020**. He delivered a talk entitled "Towards life like dynamic materials" which was part of the work carried out by his team at the New Chemistry Unit , Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore. The strategy adopted for multi-component organic polymerization and the structure and properties of supra molecules were briefly described in his talk . The program was inaugurated by Dr. A. Ajayaghosh , Director , NIIST , Trivandrum . Dr. P.P. Chandrachoodan , National President -ISAS ,Dr. V.R. Nair , Chairman , National Webinar Committee and Dr. K.G.K .Warrier , former Chief Scientist , NIIST, Trivandrum extended felicitation. Certificate of excellence from ISAS was awarded to Dr. Subi George by Dr. Ajayghosh.

All these programs were well received by the scientific community .Around 200 delegates participated in the webinar series arranged for students , researchers and teachers.



Carbon Nanotube to Bhabha Kavach

Indian Society of Analytical Scientists (ISAS), Nagpur Chapter in association with Institute of Electrical & Electronic Engineers (IEEE)&ISAS Hyderabad Chapter

Date: 3rd November 2020

No. of participants registered: 145 participants

Dr. Kinshuk Dasgupta,
Head Advanced Carbon Materials Section
and AMD Material Group, BARC , Mumbai.

Shanti Swarup Bhatnagar awardee

Indian Association of Analytical Scientists, (ISAS) Nagpur Chapter, organized a webinar on Carbon Nanotube to Bhabha Kavach on 3rd November 2020between 4:00 pm to 5:30 pm. Webinar was started with opening remark by Dr. Avinash V. Bharati, Chairman, ISAS, Nagpur Chapter and convener of the webinar followed by Dr. Raghaw Saran, Vice president, ISAS & Advisor Nagpur Chapter on activities of ISAS, Nagpur Chapter. Dr. Chandrachoodan, National President of ISAS gave the presidential address. Dr. Ranjeet, Chairman, Nagpur subsection, Institute of Electrical & Electronic Engineers introduced the resource person Dr. Kinshuk Dasgupta, Head Advanced Carbon Materials Section G and AMD Material Group, BARC and Associate Professor, Homi Bhabha National Institute **and Shanti Swarup Bhatnagar awardee.**

Dr. Dasgupta explained the various properties of carbon nanotube which makes it best suited materials for variety of applications from water treatment to energy storage materials to sensors. He also elaborated on the economical bulk synthesis of carbon nanotube as well as reaction mechanism and characterization of the synthesized materials. The economical bulk synthesis is essential for its commercial application. This was followed by incorporation of the carbon nanotube and its various composite in indigenously produced Ballistic Resistant Jacket by Bhabha Atomic Research Centre. The talk was highly informative and enriching.

The invited talk by Dr. Dasgupta was followed by Question Answer session. Dr. Dasgupta was presented with Certificate of Excellence. The citation was read by Dr R Saran whereas Dr. Chandrachoodan, President ISAS virtually handed over the same. The vote of thanks was given by Dr R Srinivas, Chairman ISAS Hyderabad Chapter. Program was compared by Dr. Priti Mangrulkar, Assistant professor, RCOEM, Nagpur.

Dr. A. V. Bharati Convener
(Chairman, Nagpur Chapter)

Webinar on Platinum Group elements in road dust, soils and waters of major world cities and their impacts on the environment and human health

by Dr. V. Balaram

Indian Association of Analytical Scientists, (ISAS) Nagpur Chapter

in association with ISAS, Tamil Nadu Chapter

Date : 17th October 2020

No. of participants registered: 205 participants

Former Chief Scientist and
Head, Geochemistry Division, CSIR
National Geographical Research
Institute (NGRI), Hyderabad

Indian Association of Analytical Scientists, (ISAS) Nagpur Chapter, organized a webinar on Platinum Group elements in road dust, soils and waters of major world cities and their impacts on the environment and human health on 17th October 2020between 6:30 pm to 8:00 pm. Webinar was started with opening remark by Dr. Avinash V. Bharati, Chairman, ISAS, Nagpur Chapter and convener of the webinar followed by Dr. Raghaw Saran, Vice president, ISAS & Advisor Nagpur Chapter on activities of ISAS, Nagpur Chapter. Dr. Chandrachoodan, National President of ISAS gave the presidential address. Dr. Shriman Narayan, Chairman ISAS, Tamilnadu, introduced the resource person Dr. V. Balaram. Dr. Balaram explained the various applications of various platinum group elements in modern day to day life. These elements find profound applications as industrial catalysts, catalytic converters of vehicles, car batteries, medicines for diagnostic and therapeutic purposes, and so on. These metals are used to catalyze the conversion of toxic constituents of exhaust fumes like CO, HCs, NOx to water, CO_2, and molecular nitrogen. This results in physico-chemical reactions as well as erosion of the catalyst surface, releasing platinum group elements from the catalyst layer into the environment along with the exhaust fumes. The platinum salts are known to have some adverse effects on health if over exposed. Hence, regulating the platinum group elements in the environment is of utmost importance.

The invited talk by Dr. Balaram was followed by Question Answer session. Dr. Balaram was presented with Certificate of Excellence. The citation was read by Dr R Saran whereas Dr. Chandrachoodan, President ISAS virtually handed over the same. The vote of thanks was given by Dr. Arun Kumar, Chairman, ISAS, Tamil Nadu Chapter. . Program was compared by Dr. Priti Mangrulkar, Assistant professor, RCOEM, Nagpur.

Dr. A. V. Bharati Convener

(Chairman, Nagpur Chapter)

X- Rays in Analytical Chemistry

Indian Society of Analytical Scientists (ISAS), national , and ISAS, Nagpur Chapter

Date: 22nd November 2020

No. of participants registered: 110 participants

Dr. Nand Lal Mishra

Former Scientific Officer and

Head, X-Spectroscopy Section,

Fuel Chemistry Division

Bhabha Atomic Research Centre, Mumbai

Ex-Professor , Homi Bhabha national Institute

Indian Association of Analytical Scientists, (ISAS) Nagpur Chapter, organized a webinar on **X- Rays in Analytical Chemistry** on 22nd November 2020 between 7:00 pm to 8:30 pm. Webinar was started with welcome of Dignituries on platform and participants by Dr. Avinash V. Bharati, Chairman, ISAS, Nagpur Chapter and convener of the webinar followed by Dr. V. R. Nayar, National ISAS webinar Committee, Dr. Chandrachoodan, National President of ISAS gave the presidential address. Dr. Raghaw Saran, Vice president, ISAS & Advisor Nagpur Chapter on activities of ISAS, Nagpur Chapter. Dr. Vijaylaxmi Adya, Former Sr. Scientist, BARC, Mumbai introduced the resource person Dr. Nandlal Mishra.

Dr. Mishra explained the various aspects about X-rays and their applications in Science, particularly in Analytical Chemistry. The talk was highly informative and enriching.

The invited talk by Dr. Mishra was followed by Question Answer session. Dr. Mishra was presented with Certificate of Excellence. The citation was read by Dr R Saran whereas Dr. Chandrachoodan, President ISAS virtually handed over the same. The vote of thanks was given by Dr. Kanungo, Vice-Chairman ISAS Nagpur Chapter. Program was compared by Dr. Priti Mangrulkar, Assistant professor, RCOEM, Nagpur.

Dr. A. V. Bharati

Convener

(Chairman, Nagpur Chapter)

Role of Natural Immunity and Vaccine in Management of Contagious Dieases

Indian Society of Analytical Scientists (ISAS), Headquarter, Mumbai , and ISAS, Nagpur Chapter with Chemistry Department, RCOEM, Nagpur.

Date;19th December 2020

No. of participants registered: 134 participants

Dr. T Balkrishna Poduval
Former Head, Immunology & Hyperthermia Section,
Bhabha Atomic Research Centre(BARC).
former Professor, Homi Bhabha National Institute

Indian Association of Analytical Scientists, (ISAS) Headquarters and Nagpur Chapter with Chemistry department, Ramdeobaba College of Engineering and Management Nagpur, organized a webinar on **Role of Natural Immunity and Vaccine in Management of Contagious Diseases** on 19th December 2020 between 7:00 pm to 8:30 pm. Webinar was started with welcome of dignitaries on platform and participants by Dr. Avinash V. Bharati, Chairman, ISAS, Nagpur Chapter and convener of the webinar, followed by virtual lightning of lamp where all dignitaries on online platform were participated. Dr. V. R. Nayar, National ISAS webinar Committee explained the role of online webinars in present scenario. Dr. Chandrachoodan, National President of ISAS gave the presidential address. Dr. Suparna Deshmukh, Professor, M K Gandhi College Ahamadnagar, introduced session chair, Dr. Anilkumar Gopinathan, Sr. Professor, School of Bioscience and Technology, VIT, Vellore. Dr. Anilkumar Gopinathan enlighten the importance and significance of this talk in present pandemic situation. Dr. Jayant D. Ekhe introduced speaker, Dr. Poduval, former Professor, Homi Bhabha National Institute and former Head, Immunology and Hyperthermia Section, BARC, Mumbai.

Dr. Poduval expressed his views on Role of Natural Immunity and Vaccine in Management of Contagious Diseases. He explained what to do and what not in these days where world is in the shadow of Corona fear. He informed about various stages and the significance of Vaccines on Corona. His talk was highly informative and enriching.

The invited talk by Dr. Poduval was followed by Question Answer session. Dr. Poduval was presented with Certificate of Excellence. Certificate was cited by Dr R. Saran whereas Dr. Chandrachoodan, President ISAS virtually handed over the same. The vote of thanks was given by Dr. Sanjiv Singh, Scientist, NEERI, Nagpur. Program was compared by Dr. Priti Mangrulkar, Assistant professor, RCOEM, Nagpur.

Dr. A. V. Bharati
Convener
(Chairman, Nagpur Chapter)

THE SCIENCE OF COVID TESTING

Compiled by

Dr. V. R. Nair, Former Chief General Manager (Corporate R&D), Indian Rare Earths

Past President ISAS

&

Chairman, ISAS, WHC Apex Committee.

As nations struggle to control the Covid-19 pandemic, the biochemical tests that can identify the underlying Sars-CoV-2 virus have become big news. In the US in early May the Trump administration set a goal of testing three million people per week. The UK government set itself a target of 100,000 daily tests by the end of April, a challenge it claims to have met, although others question this. Yet arguably even more important than the targets is what the tests tell us, and how we use that information.

Why do we need testing?

For an individual, it's the best way to answer the question we've probably all asked ourselves in recent weeks: do I have Covid-19? 'Symptoms relating to Sars-CoV-2 can be attributed to other illnesses,' comments Babak Ashrafi, Clinical Lead for Service Expansion at UK-based online doctor and pharmacy Zava. 'Without testing there's no way to really know where the virus is active, and how fast it's spreading.'

More broadly, testing provides important information about public health that can help governments to make decisions about how they should be responding to the pandemic. 'Testing can help guide actions for treatment and for routing through the health system,' comments John Bagshaw, Interim Chief Operating Officer at the British In Vitro Diagnostics Association. 'Early diagnosis may save lives as well as reducing unnecessary isolations and allowing workers to resume work, including key health and care workers.' Testing can also help find the people that have been infected without showing any symptoms. That in turn could tell us how many people have actually been infected in total, and who might be immune following infection.

Source: © Alain Pitton/NurPhoto/Getty Images

Swab sampling is the typical approach for tests that determine whether a patient is currently infected with the virus

So how do the tests work?

Overall, there are two types of test: ones that detect if the virus is present in your body right now, and ones that test whether the virus has infected your body before.

The first type is the one that usually involves taking a throat swab. This uses polymerase chain reaction (PCR)-based techniques to detect the Sars-CoV-2 RNA genetic code. First, the viral RNA strand is transcribed into a complementary DNA (cDNA) single strand by an enzyme called reverse transcriptase, so that the enzyme DNA polymerase is able to do its work in the subsequent steps. Scientists then introduce probe DNA strands called primers to the sample, which are specifically designed to find and bind only to certain sections of the viral cDNA strand. When the probe DNA strands have bound the viral cDNA, the DNA polymerase enzyme is activated and this begins to make double-standed copies of viral DNA. Some of the probe DNA strands also carry a fluorescent dye that is released when they bind to the viral DNA. As the test multiplies the viral DNA, more dye molecules are released and the fluorescence grows, indicating a positive sample. Other versions of the test work by adding a dye that only fluoresces when it binds to the double-stranded viral DNA. Either way, rather than looking for a needle in a haystack, this approach ‘is making a haystack of needles’, Bagshaw says.

There are also antigen tests, which can detect the virus’ proteins rather than its RNA. These use a slide that is covered in antibodies specific to the virus. If a sample contains viral proteins, they will will stick to the antibodies. A second, fluorescent antibody is then added, which is also designed to target the viral proteins and so will stick to any that were bound in the first step. The fluorescence intensity then gives a measure of the concentration of the virus in the sample.

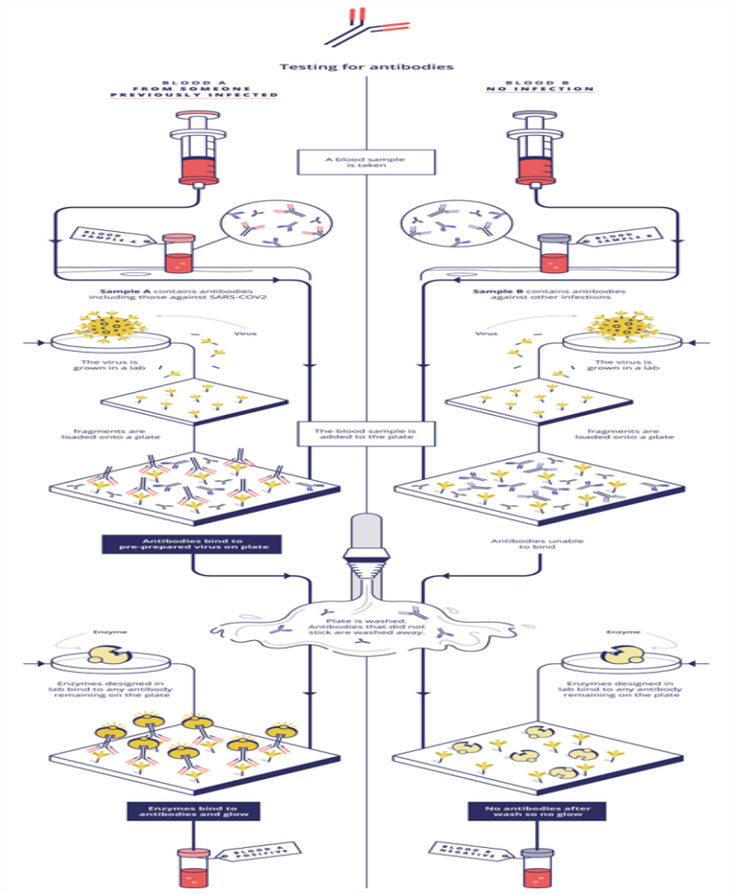
Source: Courtesy of Roche

Antibody tests must have high specificity if they are to be used to certify a person's immunity to Covid-19

So how can I check if I had Covid-19 previously?

This mainly involves detecting the antibodies our immune systems produce when they are exposed to a virus – these are found in our blood, or serum. 'A blood sample is taken into a tube or a membrane where pieces of virus have been stuck,' Bagshaw explains. If the blood sample contains Covid-19 antibodies, they will fit into these like a key in a lock, he adds.

In Elisa (enzyme-linked immunosorbent assay) methods, a second antibody type is then added. This recognises the patient's antibodies and sticks to them (if they stuck to the virus particles in the previous step). This second antibody is also linked to an enzyme. In the final step, a dye is added and if the enzyme is present (because it is linked to the antibody that is stuck to the patient's antibody that is stuck to the virus) the enzyme will break down the dye and make it fluoresce. The colour intensity is then directly linked to the Sars-CoV-2 antibody concentration in the patient's sample.



Source: Courtesy of UK Research and Innovation/CC BY 4.0, originally published at https://coronavirusexplained.ukri.org/en/article/vdt0006/

These tests target immunoglobulin M (IgM) and immunoglobulin G (IgG) antibodies, explains Simon Parker, clinical market manager of Roche Diagnostics in the UK. The IgM response comes when we are sickest, and IgG as the immune response matures, he says. For example, Roche's Elecsys Anti-Sars-CoV-2 immunoassay identifies specific high affinity Sars-CoV-2 antibodies, mainly IgG and some IgM. Elecsys is an electrochemiluminescent system, which produces light only when an electric current is applied. Zava exploits another variation on this theme, with a chemiluminescent microparticle immunoassay that similarly uses the light output used to measure antibody levels. Zava's test detects IgG antibodies to Sars-CoV-2 in human serum, explains Ashrafi.

Why has it been difficult to access Covid-19 tests?

Initially there had been problems with supply of reagents for PCR tests, but Bagshaw and Ashrafi say that these have now been largely resolved in the UK. The issue now is ensuring test accuracy, or more precisely their specificity and sensitivity. Sensitivity relates to the proportion of positive cases a test detects. Specificity refers to the number of false positives it returns, and is a key focus for Bagshaw.

As we move to a stage where the numbers of people testing positive is falling, highly specific tests become more important. Bagshaw explains this with an example: if a test is 100% sensitive, it will never miss a true positive. But if it is 99.5% specific, it will also give one false positive in every 200 samples. In a sample of 1000 people with a 1% infection rate, he'd get 10 true positives and five false positives. 'Two thirds are correct and one third are wrong,' he stresses.

Antibody testing could be even more difficult, he adds. 'If it is for some kind of immunity certification, it is vital that as few as possible false positive results are generated, as these could result

in exposure of vulnerable individuals to risk of infection.' The further the specificity is from 100% the more 'immunity passports' would be dangerously wrong, Bagshaw notes.

For example another type of antibody test called a lateral flow immunoassay (LFIA), which uses the same technology as a home pregnancy test, has been develop to test blood drops from a finger prick. However, recently the UK National Covid Testing Scientific Advisory Panel found that the LFIA tests ranged from 65-85% sensitive and 93-100% specific. The UK Medicines and Healthcare products Regulatory Agency has set a minimum 98% specificity threshold for LFIA. The panel therefore concluded that those currently available 'do not perform sufficiently well for individual patient applications'.

The Roche Elecsys antibody test uses blood samples taken from patients by qualified healthcare professionals, Parker says. When analysed on a Roche testing platform the test claims 100% sensitivity after more than 14 days from PCR confirmation of SARS-CoV-2 infection and over 99.8% specificity.

What about new types of test?

Many different types of test are being developed to help resolve the Covid-19 crisis. One notable version uses the gene editing tool Cripsr, with different versions being developed by two companies, Mammoth Biosciences and Sherlock Biosciences. The tests use an enzyme – usually Cas9, Cas12 or Cas13 – that is associated with RNA strands that are designed to bind to sections of the viral RNA. It also includes RNA strands that contain 'reporter' sequences that act as the signal. When the viral RNA is bound, the Cas enzyme is activated to begin cutting RNA strands, which releases the reporter RNA sequences. These Crispr-based methods cause colour changes on paper strips to indicate the presence of the Sars-CoV-2 virus quickly and cheaply.

Roche's Parker notes that Covid-19 has also pushed the rapid development of better PCR and antibody methods. 'The speed of the Sars-Cov-2 virus pandemic has meant that tests that normally take two or three years to develop have had to be developed in months,' he says. 'This has never happened before in our lifetime.'

Carbon Dioxide Sequestration in Deep Saline Aquifers

Dr. Pradeep Kumar

Senior Scientist Bhabha Atomic Research Centre, Trombay

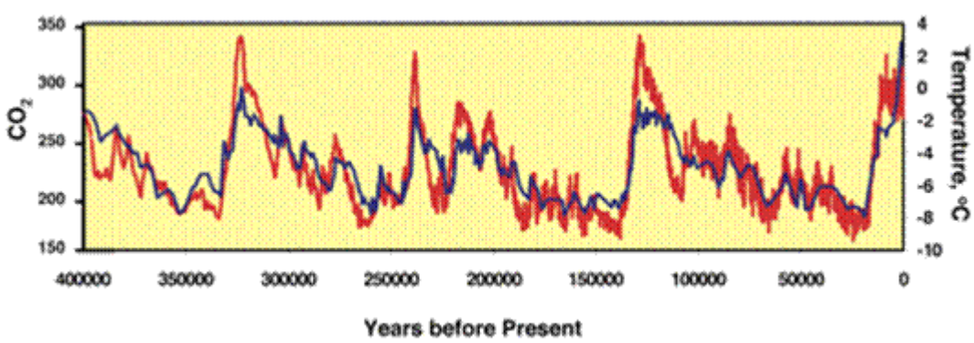
Vice president and Chief Editor ISAS

Dr. Pradeep Kumar has carried out Post Doctorate from Orlean University France on carbon dioxide sequestration in deep saline aquifers

Author's Photo in Fracne

Introduction

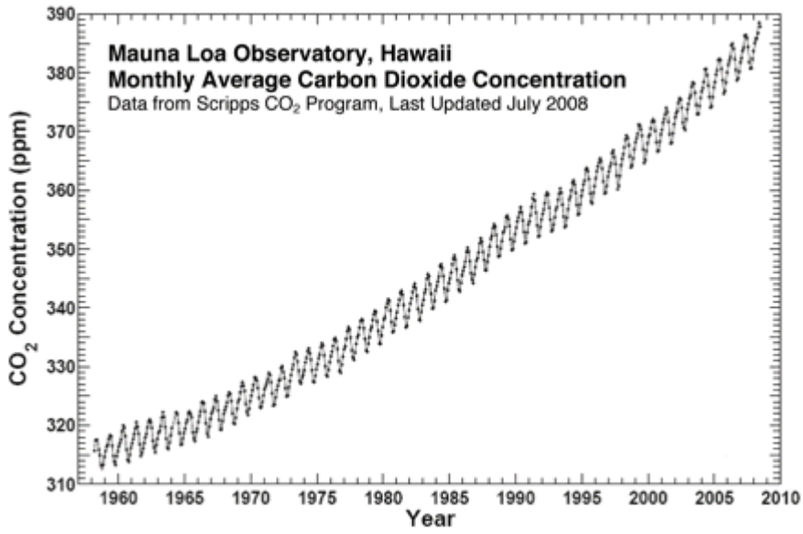
With the progress in human civilization, energy demand has increased manifolds which has been mainly supplemented by fossil fuels: Coal, oil, gas. Consequently release of CO_2 in the atmosphere occur which unbalances the global carbon cycle. Presence of extra CO_2 in the atmosphere is correlated with global warming (Fig.1). Global warming is considered responsible for the global climate changes which can be seen these days. There are many dangers associated with global warming. It is feared that that as consequence of global warming, polar ice melting might enhance raising the sea level, droning many coastal cities. Decrease in the pH of sea water is predicted. Already pH of sea water has decreased by 0.1 unit and expected to decrease by 0.3 to 0.4 unit by the end of century. Acidification of sea destabilizes calcite and aragonite which are shell of marine organism, thereby effecting marine life as well.



Atmospheric CO_2 concentration (in ppm per volume) compared with global temperature as derived from ice –core data over the past 400,000 years.

In addition, global warming might effect thermohaline operation as with the polar ice melt, salinity of sea would decrease leading to large reduction in thermohaline ocean circulation, slowing down of currents that carry warm gulf of Mexico water to north Britain and Norway thus cooling north Atlantica.

At present, developed nations are the main consumer of energy. However, energy demand scenario is undergoing rapid change and energy demand from developing nations is increasing mainly from India, China. The increase in energy demand is due to rapid industrial growth coupled with rising population growth. It is estimated that the global energy demand would increase by 40% by 2030 and might be double by the end of the century. ~75% energy demand would be arising from the developing countries. In future also, this energy demand would be met mainly by fossil fuels. Thus CO_2 conc. in atmosphere would go on increasing.



Atmospheric CO_2 concentration (in ppm) measured at the Mauna Loa observatory over last 50 years.

The graph in displays how rapidly CO_2 concentration has been increased in the recent years. It can be seen from graph that CO_2 conc. has increased from 325 ppm in 1970 to 380 ppm in 2000. This rising trend is alarming and envisages the need for CO_2 sequestration. Already it is too late. According to one estimate, at present level of energy consumption, the required reduction in CO_2 amount is roughly by factor two. However, if increase in energy demand is to be taken into consideration, the required reduction would be by factor of four.

CO_2 Capture, Transport and Storage

CO_2 sequestration comprises of three steps: Capture, Transport, Disposal. The first step is capture of CO2 from emission source or atmosphere, then transportation to storage site and finally disposal. The "CO_2 Capture" is complicated due to heterogeneous nature of CO2 emission sources. Also CO_2 emission consists of mixture of gases NO_x, SO_x, requiring separation. In the capture of CO2 from power plants, coal is treated with steam. 60% CO2 emission comes from point source which is advantageous from capture point of view. In literature mentions direct capture from atmosphere, but not much progress has occurred so far, due to diverse nature of CO_2 sources. This technique could be suitable for vehicle, plane etc.

Pipelines are the best suited for transportation of CO_2. The other method could be compression of CO_2 gas and transportation by tanker ships. The third step is storage of CO_2 in some suitable medium over long time period of the order or thousands years. The possibilities are burial in spent petroleum reservoirs, burial in saline aquifers, disposal in deep sea water etc.

Possible Storage Options

Various options exists for CO2 sequestration. The important ones are discussed following sections.

Burial in spent petroleum reservoirs

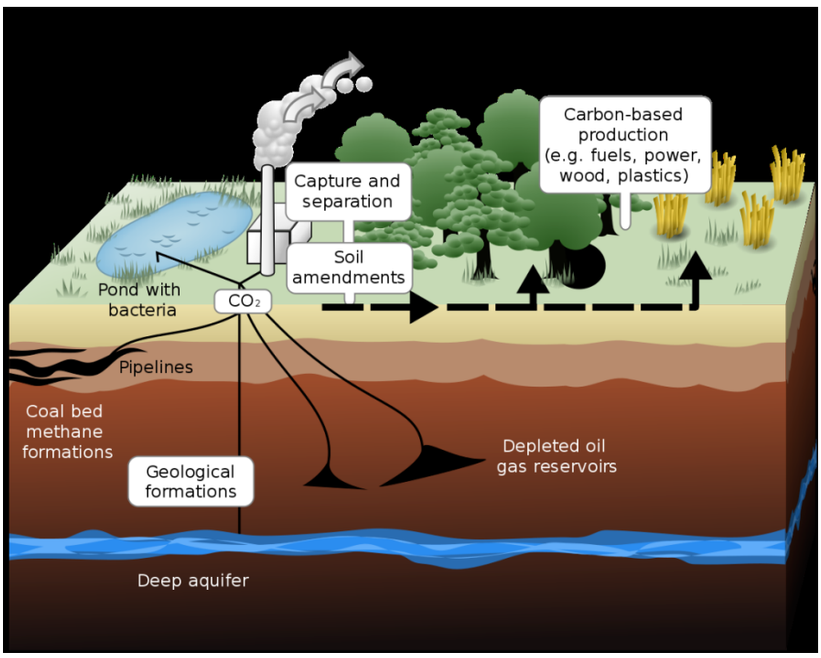
Oil fields are meant for extracting petroleum, but only half petroleum comes out easily. For financial favourable, enhanced oil recovery methods are implemented. In one method CO_2 is injected into reservoir to decrease oil viscosity. Again CO_2 is carried back to surface separated and reinjected. This is of course not a storage solution. But, it is noteworthy that large quantities of CO2 are needed and have to be transported to the reservoir. However, after the completion of EOR, the reservoir can be converted into CO_2 storage depot.

Burial in saline aquifers

Large regions of every continent are underlain by sedimentary rocks. Below one kilometer depth, pores are filled with hyper saline water, which has no agriculture value. CO_2 could be sequestered in these sedimentary basin rocks. The capacity of CO_2 storage by geological medium is significant and has adequate retention time of the order of millennium years. By injecting CO_2 at high pressure, these pores could be partially displaced from water. Norway company (Statoil) is successful disposing CO_2 separated from natural gas.

Disposal in deep sea water:

Sea has vast uptake capacity, it occupies ~70% of the earth's surface having average depth of 3.8 km. In sea, CO2 after dissolution gets neutralized to HCO_3^- by reacting with carbonate, borate and $CaCO_3$ rich sediments which cover much of deep sea floor. This option is not very successful due to large area requirement and related effect on marine ecosystem. Also, deep ocean circulation would bring back CO_2 to atmosphere on time scale of centuries. Another option could be pumping of liquid CO2 down into deep sea water. In depth exceeding 3.5 km liquid CO2 is denser than seawater consequently it would sink.



The viability of ocean storage as CO2 sequestration option hinges on social, political and regulatory considerations. In view of public precaution towards ocean, it is necessary that all parties (private, public, non-government) be included in ongoing research and debate.

Disposal in basalt

Layered basal provinces, such as the Columbia River sequences in USA, the deccan traps in India, the Siberian Basalts in Russia, and many other not only storage depots, but a mean of low tempera rue mineralization. But lot of research is required in this field.

Lakes beneath ice caps

Although very likely unacceptable proposal from environmental perspective, CO2 disposal in lakes beneath Antractica ice cap is geochemically sound storage option. At prevailing pressure and temperature, CO2 would form clathrate which would settle down to bottom. These clathrates would not dissolve.

Mineral Carbonation

In this process, stable $MgCO_3$, $CaCO_3$ are formed by reacting with CO_2 with silicate minerals containing Mg,Ca. These minerals are *VERY STABLE* on geological timescales. So sequestration by this method minimizes the leakage risk to atmosphere. But on industrial scale operation would require mining and grinding of suitable Mg, Ca bearing silicate minerals and the disposal of vast quantities of end product carbonate minerals.

How much CO2 Sequestration is Possible?

There exits high level of uncertainty on capacity estimation. According to one estimate depleted oil and gas reservoirs could store 675 to 900 Billion tonne of carbon (Gt). Saline aquifer could store 1000 to 10000 Gt of C where as Coal field can store 3-200 Gt of C. This much capacity is sufficient for storing hundred years of CO_2 emission.

CO_2 Sequestration in Deep Sediments

To significantly reduce global CO2 emission to preindustrial level, huge volumes of CO2 need to be sequestered. For example, a coal plant emits 8 million tonne CO_2 per year which is equivalent to 10 million cubic meter (Mm^3)per year. So in 50 years it would release 500 Mm^3 of CO_2. So high capacity is desirable for sequestering such huge amount of CO_2. Large sedimentary basins are nicely suitable as they posses tremendous pore volume and are widely distributed world wide. The suitable sediments should have adequate permeability so that it can easily take CO_2 at high flow rates. Suitable formations are located deeper than 800 meter. At this depth, sediments have thick and extensive seal and adequate porosity and permeability. At the prevailing high pressure CO2 has high density. Due to high density larger volumes of CO2 could be sequestered. High density facilitates efficient pore filling. Also due to high density buoyancy differences with the in-situ fluid lessens.
The medium should be able to confine the CO2, so as to prevent the migration and leakage of CO_2 to subsurface or to shallow portable ground water. Sedimentary basins are nicely suited for this purpose. Only sandstone and carbonate rocks have the desired porosity and permeability. Shales and evaporates (cap rocks) such as salt beds and anhydritre, provide primary physical barrier. Crystaline, metaphoric and volcanic rocks such as granite and basalsts are not suitable.

World Scenario on CO_2 Sequestration

The world scenario of CO_2 sequestration plants is as follows:

Commercial Projects: Three

Pilot Scale : Two

Upcoming : Commercial 6; Pilot Scale 5

Commercial Projects : Sleipner, Norway (1996).

(in Operation) Salah, Algeria (2004).

Snohvit, Norway (2008).

Pilot plants in operations: Nagaoka, Japan (2003)

Frio , USA (2005)

Proposed Commercial Plants :

Gorgon (Australia)

Mongstad (Norway)

E.ON (UK)

ZeroGen (Australia)

RWE IGCC (Germany)

Vattenfall (Germany)

Proposed pilot plants.

Ketzin (Germany)

Otway I & II (Australia)

RCSP-Phase II (USA)

RCSP-Phase III (USA)

HARP, WASP, ASAP, Aquistore (Canada)

The first operations injecting CO_2 into saline aquifers in the early 1990's were acid-gas (H_2S-CO_2) disposal projects in Canada. The first commercial –scale project with the sole purpose of disposing CO_2 from gas production started in 1996 at sleipner in the Norwegian sector of the North Sea. By 2007, approximately 15 Million Tonne CO_2 has been successfully injected into saline aquifers by commercial plants. The data gives confidence that with proper choice of geological and reservoir conditions, significant CO_2 volume of the order of 1 Million tonne per year could be sequestered. The reservoir characteristics and operating conditions vary globally.

Aquifer permeability at Sleipner is higher than other geological sites. The aquifers at Salah has low permeability, but limited monitoring information. Nagaoka and Frio has have very good monitoring and verification programs, but has low injection rates/volumes. Sleippner has 4D seismic verification system, which is very effective but costly. Sleippner has also 4D gravity verification system, low cost and work well monitoring surfacial CO_2 saturation. At Nagaoka and Frio have 4D vertical seismic profile (VSP) ,good for source signal Control and cross well electromagnetics, but additional injector well is required.

Derivative Spectrophotometry

Dr. R. Saran

Vice President ISAS

Introduction

Derivative spectrophotometry (DS) is an analytical technique of great utility for extracting both qualitative and quantitative information from spectra composed of unresolved bands. Although it was introduced in 1950s[1-3]and has demonstrable advantages for the solution of specific analytical problems, the technique has been accepted only hesitantly, because of the initial lack of reasonably priced instrumentation and original limitation to the first derivative. However, in 1970s, the introduction of electronic differentiation by a microcomputer interfaced with the spectrophotometer makes possible the plotting of the first, second or higher order derivatives of a spectrum with respect to wavelength. This enhanced applicability of derivative method; derivatization of spectra augments selectivity by eradicating spectral interferences[4-5].

The derivative method has found application not only in ultraviolet-visible region spectrophotometry, but also in infrared[6], atomic absorption and flame emission spectrometry [7-8] and also in fluorimetry (normal[9] and synchronous scanning[10]). The use of derivative spectrometry is not restricted to special cases, but may be of advantage whenever quantitative study of normal spectra is difficult. Its disadvantage is that the differentiation degrades the signal to noise ratio, so that some form of smoothing is required in conjunction with the differentiation[11]. DS utilizes spectral selectivity rather than chemical selectivity and thus it leads to process analytical chemistry to reduce analysis time.

The principle involved in DS is that (i) the derivative amplitude in a particular order is proportional to analytical concentration and (ii) $D_n \alpha (1/W)^n$ i.e the derivative amplitude D_n of the n^{th} derivative varies as inverse of the n^{th} power of the band width of the normal spectrum.

Therefore, the differentiation discriminates against broad bands, emphasizes sharper features with increasing derivative order, and increases the detection sensitivity of minor spectral features, as for two bands A and B with equal absorbances but different width, the derivative amplitude of the sharper band (with less band width) is greater than that of the broader band and is given as

$D_n, A/D_n, B \alpha (W_n, B/W_n, A)^n$

for quantitative analysis,

if Beers law is obeyed for the normal spectrum

i.e. $A = \varepsilon . c. L$

(where ε is molar absorptivity, c the concentration and L is the path length)

$d^nA/d\lambda^n = (d^n \varepsilon/d \lambda^n). L. c$

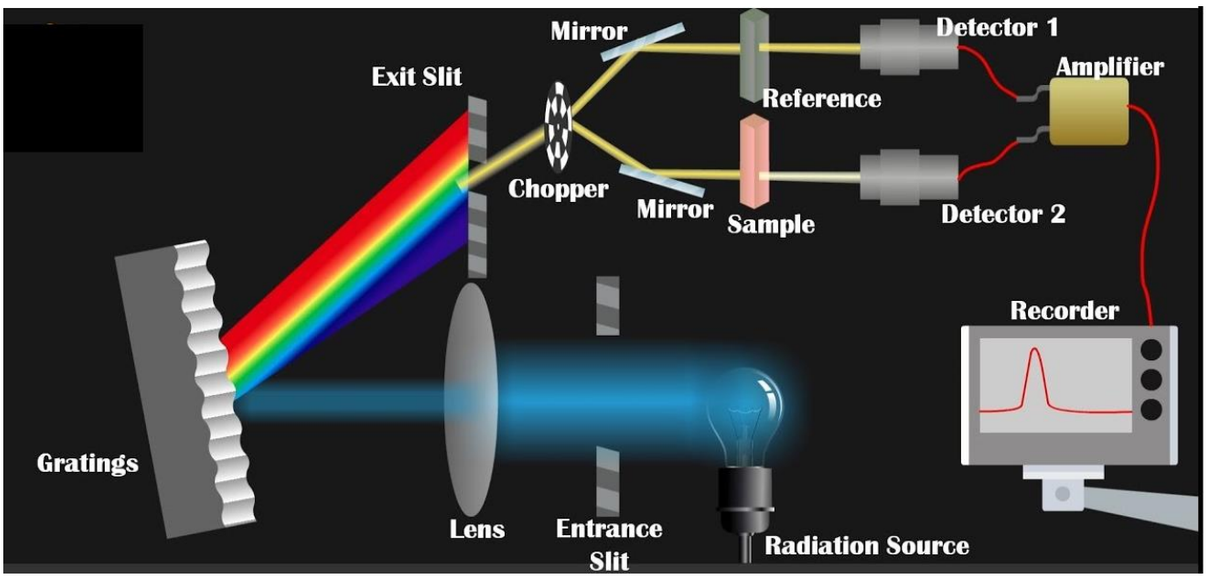
i. e. $d^nA/d\lambda^n \alpha c$ at a particular λ

As at the particular wavelength $d^n \varepsilon/d \lambda^n$ is constant.

The characteristics of DS depends on the instrumental parameters selected and are optimized with respect to (i) reducing of noise levels (ii) stability of zero points.

The best results are obtained at a scan speed of 100 nm/minute over the wavelength range, with a wavelength interval of 0.5 nm for the differentiation, usually..

Although, in recent years, the use of diode-array spectrophotometers the data from which are easily converted into nth derivatives, has facilitated the use of the derivative technique in a wide field of applications[12], the DS by the convolution method is often used especially after the development of microprocessor-controlled spectrophotometers.



The way of obtaining the derivative orders

Derivative spectroscopy accomplishes conversion of a normal or zero order spectrum to its first, second or higher derivative spectrum. It yields considerable changes in shape of derivative achieved. Appropriate selection of derivative order gives useful separation of overlapped signals. Criterion like signals height, their width and distance between maxima in basic spectrum is achieved by optimal derivative order, to attain wide spectrum bands it is expected to use low orders and for narrow spectral bands-higher orders. A Gaussian band represents an ideal absorption band gives clear idea about transformation occurring in the derivative spectra. Plotting absorbance versus wavelength gives a graph, showing peak with maxima and minima (also points of inflection) that is supposed to pass through zero on the ordinate[13] (Fig. 1)

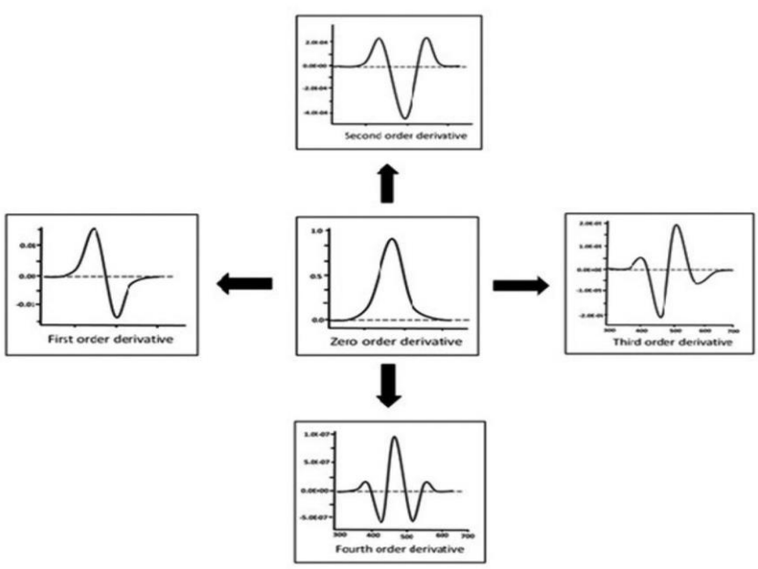


Fig. 1

Removal of Interferents

To avoid usual course of the tedious time consuming process of the separation of interferents from analyte, help is taken of different orders of derivatives.

First of all, the wavelengths at which interferent spectra are resolved is determined by the zero point wavelength (ZPW) method. In the method, derivative amplitude of the analyte is measured at the wavelength of zero crossing point of the derivative spectrum of the interferent. The zero point wavelength is confirmed by Point of Intersection (PI) method also referred as zero crossing method by some authors. In this, the wavelength at which the derivative spectra of the binary mixture of the analyte & interferent and that of analyte intersect is investigated. At these points the derivative amplitudes of the binary mixtures are equal to the derivative amplitude of the analyte i.e. at this wavelength, the amplitude of the derivative signal of the interferent passes through zero and therefore the derivative amplitude of the mixture at the intersection point is function of analyte concentration only and not of interferent.

The coinciding of zero point wavelength with point of intersection confirms the zero point wavelength for the interferent and indicates a "no shift in zero point wavelength" for the varying amounts of interferent in the concentration range studied. In case a shift is observed in zero point wavelength for the interferent in a particular order (analogous to the λ max of the ordinary spectra with increasing concentration); higher order derivatives are explored.

In case there is no shift in zero point wavelength in a particular order of derivative for an interferent in a concentration range, and if on exceeding the concentration range there is a shift in zero point wavelength; higher derivatives are explored; in case these do not show shift – the boundary concentration is checked in both the orders, and the tolerance range of the interferent is expanded utilizing the derivatives in the order suitable to the concentration range.

Different methods have been used to find derivative amplitude by various workers such as by measuring (i) the vertical distance between a consecutive maxima and minima (ii) the vertical distance from a base to peak (iii) the vertical distance between a peak and shoulder. In the UV-Vis spectrophotometer, Hitachi U-2000, used by us, the derivative spectra is obtained by digital differentiation (convolution method) with 17-25 data point around each wavelength.

In case zero point wavelength for two or more interferents coincide; the zero point wavelength is checked in ternary or higher mixtures of analyte & the two or more interferents; and if zero point wavelength and point of intersection coincide, the tolerance for all the interferents explored (usually ternary mixtures).

Spectral measurements

A reagent blank solution (prepared as described in the procedures without analytes) is placed in sample and reference cell and scan is obtained in the desired wavelength range to setup the base line. The blank solution in the sample cell is replaced with the sample solution and spectral scan is repeated at a scan speed of 100 nm per minute over the wavelength range and the spectrum recorded is stored in a save scan file. The derivative spectra are recorded. The analyte content is determined from the derivative spectra by measuring the derivative amplitude at the zero-crossing point for the interferent and comparing the value with an appropriate calibration graph.

In case simultaneous determination is to be carried out, say for example, of nickel and cobalt with 5-(2 – carboxyphenyl) azo-8-hydroxyquinoline in non-ionic micellar medium of Triton X -100, first derivative spectrophotometry is utilised. The reagent blank is scanned from 650 nm to 400 nm to setup the base line. Spectral scan over the wavelength range (650 – 400 nm), recorded is saved. The first derivative spectra is recorded. The nickel content is determined from first derivative spectrum amplitude at zero-crossing point for cobalt (473.5 nm) and cobalt content is determined by measuring the first derivative amplitude at the zero-crossing point for Ni (II) (505.0 nm, 509.0 nm) and the values are determined by comparing with appropriate calibration graph.

Disadvantages

Even though the method is sensitive it is highly susceptible to various parameters. The method is limited to particular system only and has limited applications due to its less reproducibility. The method is second choice when existing instrumental method (which measures signal) is absent. It is less accurate in measuring zero-crossing spectra. There is likeness in shape of derivative spectra and zero order spectrum, so small variation in a basic spectrum can strongly modify derivative spectrum. Poor reproducibility can alter results in way when different spectrophotometers used for zero order spectra gives similar results but derivatization of them display different[14].

Applications

Single component analysis: Derivative spectrophotometry analyses single component along with Area under Curve in pharmaceutical formulation.

Multicomponent analysis: Derivative spectrophotometry in pharmaceutical analysis analyses more than one component in presence of other components i.e. simultaneous determination of two or more compounds. Spectral derivatization can remove the prevalence caused by spectra of disturbing compounds [15].

Bioanalytical application: Besides pharmaceutical analysis, derivative spectrophotometry may be applied to different areas such as determination of compounds in various biological samples like plasma, serum, urine and brain tissue.

Forensic toxicology: Derivative spectroscopy has its application in toxicology especially of illicit drugs viz; amphetamine, ephedrine, meperidine, diazepam, etc. and can also be used in mixtures.

Trace analysis: Derivative signal processing technique is widely used in practical analytical work in measurement of small amounts of substances in the presence of large amounts of potentially interfering substances. Due to such interference, analytical signals becomes weak, noisy and superimposed on large background signals. The conditions like non-specific broadband interfering absorption, non-reproducible cuvette positioning, dirt or fingerprints on the cuvette walls, imperfect cuvette transmission matching, solution turbidity and wavelength-independent (light blockage caused by bubbles or large suspended particles) results in degraded measurement precision (which otherwise too have similar effects in normal spectrophotometry) by sample-to-sample baseline shifts. Baseline shifts may be due to practical errors, either are weak wavelength dependence (small particle turbidity). So, there is need of differentiation of relevant absorption from these sources of baseline shift. It is expected to suppress broad background by differentiation with an aim to reduce variations in background amplitude from sample-to-sample. This results in improved precision and measurement in many instances, especially in case if there is a lot of uncontrolled variability in the background and when the analyte signal is small compared to the background.

In continuation of our analytical work[16-19] on the use of 5-(2'- carbomethoxyphenyl) azo – 8 – quinolinol, we developed a sensitive method for the determination of Hg (II) using an anionic surfactant to solubilize the mercury complex by hydrophobic interaction[20-21]. The selectivity was achieved by using derivative spectrophotometry[22] to resolve closely overlapping absorption bands due to Cu (II), Co (II), Pb (II), Ni (II), Zn (II) and Cd (II), a technique less often used in inorganic analysis[23]. The calibration curves were found to be linear at wavelengths representing ZTS for the interferent studied (Table 3 and 4) in different order derivatives of the absorption spectra for 0.08 – 1.6 ppm of Hg (II) in final solution[22].

Conclusion

Derivative Spectrophotometry is presently available with software's controlling modern spectrophotometers. This makes easy to analyst in obtaining useful information from spectra of respective compounds. The derivatives of UV spectra give applicable information in elucidating compounds in pharmaceutical formulation.

References

1. V.J. Hammond and W.C. Price, J. Opt. Soc. Am. , 43 924 (1953).
2. J.D. Morrison, J. Chem. Phys.,21, 1767 (1953).
3. A.T. Giese and C.S. French., Appl. Spectrosc. , 9, 78 (1955).
4. D. Cameron, D. Moffatt. Apl Spec. 41, 539-44, 1987. [Links]
5. S. Kus, Z. Marczenko, N. Obarski. Chem Anal. 41, 899-927, 1996. [Links]
6. I.G. McWilliams, Anal. Chem., 41, 674 (1969).
7. W. Snelleman, T.C. Rains, K.W. Yee , H.D. Cook and O. Menis, ibid, 42, 394 (1970).
8. W.K. Fowler, D.O. Knapp and J.D. Winefordner, ibid, 46, 601 (1974) 165.
9. T.C. O Haver, in E.L. Wehry (ed.), "Modern Florescence Spectroscopy", Vol. I, Plenum Press, New York, p.65, 1976.
10. P. John and I. Soutar, Anal. Chem., 48, 520 (1976)
11. T.C. O Haver and T. Begley, ibid, 53, 1876 (1981).
12. B. Grego, E.C. Nice and R.J. Simpsom, J. Chromtog., 352, 359 (1986).
13. Beckett AH, Stenlake JB. Practical Pharmaceutical Chemistry. [Links]
14. J. Karpińska. Talanta. 64, 801-822, 2004. [Links]
15. A. Owen. Uses of Derivative Spectroscopy, UV-Visible Spectroscopy, Application Note, Agilent Technologies, 1995. [Links]
16. R. Saran, V. Umashanker and G. V. Ramanaiah, Anal. Lett., 1990, 23, 2291.
17. R. Saran, V. Umashanker and G. V. Ramanaiah, Bull. Chem. Soc. (Jpn), 1992, 65, 2291.
18. R. Saran, T. S. Basu Baul, P. Srinivas and D. T. Khating, Anal, Lett., 1992, 25, 1545.
19. R. Saran, A. K. Sardana, and G. V. Ramanaiah, Indian J. Chem. Technol., 1994, 1, 258.
20. K. S. Birdi, H. N. Singh and S. B. Dolsager, J. Phys. Chem. 1979, 83, 2733.
21. H.C. Chiang and A. Kukton, J. Phys. Chem. 1975, 79, 1935.
22. R. Saran and T. S. Basu Baul, Talanta, 1994, 41, 1537.
23. A. G. Melgarejo, A. G. Cespedes and J. M. C. Pavon, Analyst, 1989, 114, 109, and refs therein.

Role of Natural Immunity and Vaccine in Management of Contagious Diseases

Dr. Balakrishna Poduval

After M.Sc. in Biochemistry from University of Mysore, Selected for the BARC training School on a National basis and obtained his PhD related to BCG Immunotherapy from Mumbai University. Dr. Balakrishna Poduval was Former Professor, Homi Bhabha National Institute(HBNI), Former Head, Immunology & Hyperthermia Section, Bhabha Atomic Research Centre(BARC). PhD guide at HBNI and Mumbai University. He along with his team at BARC has contributed immensely to original knowledge in the area of Immunology and Critical care medicine related to Inflammation, Heatstroke Acute Radiation Syndrome and Septic Shock. His team also has original contribution in the area of Cancer, Radiation Biology. 45 peer reviewed high impact publications relating Cancer, Radiation Biology, Immunology, Stress biology. 4 papers in Number 1 primary cancer journal. Listing in International Medical Encyclopedia article on Heat stroke (Hyperthermia)

Based on Webinar by Podval

1) **It is not Pandemic**
2) **Virus Mapping for Causal Relationship with the disease as per Procedure Not done**
3) **RT PCR does not detect infective virus/ not specific and error prone**
4) **It is Flu Like Illness and no increased mortality**
5) **We have already achieved Immunity to Virus.**
6) **Efficacy of Vaccine**

Vaccination by NATURE VS Laboratory

Swine Flu Pandemic

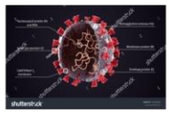
- Dr. Wodang Medical Doctor, Epidemiologist, Head of Health at Council of Europe which represent human rights of 47 countries states: Greatest Scandal of 2009.

- Millions of dose of vaccine and Tamiflu contract was sealed by the Governments wasting huge sums of public money. He tabled a motion in Parliament assembly of 47 countries titled " Faked Pandemic- a Threat for health.
- He was critical of Secret Changed definition of WHO to accommodate the pandemic.
- Golden Triangle of WHO, pharma And Academic Scientists. The scientist involved in the Flu was jailed for hiding the truth regarding Tamiflu.
- Tamiflu was launched by Roche and Gilead who are currently very active in all the aspects of the current disease.

Pandemic: Changed WHO Definition

- OLD: An influenza pandemic occurs when a new influenza virus appears against which the human population has no immunity, resulting in several simultaneous epidemics worldwide with enormous numbers of deaths and illness.

New: The word enormous numbers of deaths and illness removed. Only no immunity word retained." This enabled the declaration of a pandemic without having to demonstrate the intensity of the disease caused by the H1N1 virus called Swine Flu.



No Immunity ?
Cell 181:1489, 2020

- Immune cells (T cells) seen in 100% of recovered Covid Patients correlates with Antibody
- **Blood cells from 40-60% of Unexposed individuals (2015)reacted to SARS-CoV2 antigens**
- Suggesting Immunity to Current Virus (**CV**) By Natural Vaccination by common cold Viruses of the same family.

Strong IMMUNITY Both Natural and Acquired= NO PANDEMIC

If there is no Pandemic the year 2020 would have been normal like any year

WHO Death Prediction March-20

- **World:** If no lockdown or social distancing or other preventive measures: nearly 4 crore people will be killed worldwide
- prevention and lockdown measures: 2 crore people will die worldwide in the next few months.
- **India:** If no lockdown or social distancing or other preventive measures are taken, then up to 60,96,359 people will die and

✓ If all the WHO guidelines of lockdown or social distancing are followed then about 23,75,803 people will be killed due to Covid-19 in the next few months.

Virus Mapping Not done

Koch father of Infective Microbiology

The 4 parameters laid by the great microbiologist and its modification by Rivers Fredricks and Relman Not followed, which means the infectious agent responsible for the current ailment could be any of the 200 respiratory viruses or even bacteria. (Details in the next slides. Go through only interested)

The original WUHAN virus SARS CoV2 is not isolated or purified.

The Causative Agent of Covid19 not established. The presence of the RT PCR positive RNA sequence is a chance association. The disease could be caused by 200 other Respiratory viruses and also Bacteria.

Then how diagnostic kit, vaccine possible.?

Koch hypothesis

The microorganism must be found in abundance in all organisms suffering from the disease, but should not be found in healthy organisms. (Asymptomatic)

The microorganism must be isolated from a diseased organism and grown in pure culture.

he cultured microorganism should cause disease when introduced into a healthy organism.

The microorganism must be reisolated from the inoculated, diseased experimental host and identified as being identical to the original specific causative agent

Koch's postulates for the 21st century as suggested by Fredricks and Relman

Clinical Microbiol Reviews 9:18, 1996.

A RNA sequence of CV should be present in most cases of an infectious disease.

Fewer, or no, copy numbers of pathogen-associated RNA sequences should occur in hosts or tissues without disease. 85% Asymptomatic

When sequence detection predates disease, or sequence copy number correlates with severity of disease or pathology, the sequence-disease association is more likely to be a causal relationship (ICMR; No Correlation)

Tissue Sequence correlates should be sought at Cell level

The sequence based evidence should be reproduced.

RT-PCR and Cases

Not approved by FDA (USA) to test a virus

Not approved by manufacturer of the test to diagnose virus.

The test cannot detect active Virus(The Nobel Laureate Mullis)

PCR Contamination and human error can add up to 15% error.

For 15 Crore tests, 1% error is = 15 Lakhs. The positives are called Cases nothing to do with Disease load.

Case Definition

WHO defines a confirmed case as a person with a **positive** test result, "irrespective of clinical signs and symptoms.". This is a departure from **historical practice**.

In previous epidemics case definitions required individuals to be symptomatic

First time Normal healthy people are being subjected to Testing

India > 160 million Tests Mind Boggling

RT PCR Cross reactivity with other Corona Viruses Kit Manufactured by DTPM

Based on the in silico analysis, SARS-CoV and other SARS like **CV**s in the same subgenus (Sarbecovirus) as SARS-CoV2 may **cross-react with the COVID-19 RTPCR test.**

Other Corona viruses are **not known to be currently circulating in** the human population, and therefore highly unlikely to be present in patient specimens.

Not Correct

Cell 181:1489, 2020

Science 370:1339,2020

ACCELERATED EMERGENCY USE AUTHORIZATION (EUA)

SUMMARY COVID-19 RT-PCR TEST

Positive results are indicative of the presence of SARS-CoV-2 RNA; clinical correlation with patient history and other diagnostic information is necessary to determine patient infection status. Positive results do not rule out bacterial infection or co-infection with other viruses.The agent detected may not be the definite cause of disease.

Indian Council of Medical Research Department of Health Research, Ministry of Health and Family Welfare, Government of India

Date: 05/08/2020

Evidence Based Advisory on Correlation of COVID-19 Disease Severity with Ct Values of the Real Time RT-PCR Test

The cycle threshold or Ct value of a RT-PCR reaction is the **number of cycles** at which fluorescence of the PCR product is detectable over and above the background signal. Theoretically, the Ct value is inversely proportional to the amount of genetic material (RNA) in the starting sample and lower Ct values generally correlate with high viral load.

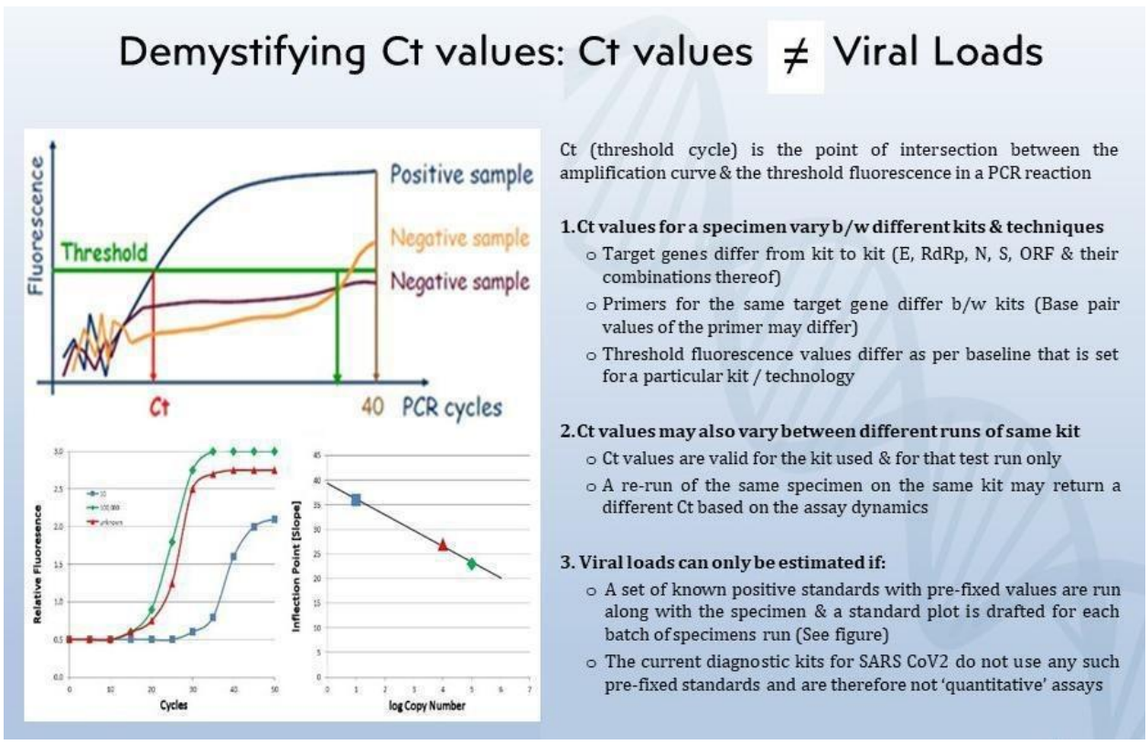
It is being assumed by some researchers / clinicians that high viral load directly correlates with increased infectiousness and severity of disease. However, the evidence is not robust enough.

Source of Errors ICMR

Poorly Collected Sample, technical competence, calibration of equipment, pipettes and analytical skills of the interpreters. Nasal and oropharyngeal specimens collected from the same individual may differ. Temperature/transportation/ time taken. Samples from asymptomatic/mild cases show Ct values similar to those who develop severe disease.

- In view of the above, it is not recommended to rely on numerical Ct values for determining infectiousness of COVID-19 patients and deciding patient management protocols.

Huge Kit to Kit Variation



Asymptomatic

The word Asymptomatic should have been music to ears. It is an Healthy Happy Harmonious word indicating in spite of Viral infection you are Fine because you could eliminate the virus.

But this word converted into a Disaster. You should admire the Vested interest/Media for such a mind manipulation.

Maria the Technical Director WHO based on Scientific evidence stated that Asymptomatic does not spread the virus. Dr Fauci pounced on her to take back the statement.

The whole plandemic depends on this word. This makes you a source of deadly virus and hence Mask, house arrest (quarantine) to prevent the enemy escaping

It is

Influenza Like Illness (ILI)

Symptoms of Flu and current Flu

Covid19 comes under Influenza like diseases acknowledged by our health secretary

CDC: Influenza (Flu) and COVID-19 are both contagious respiratory illnesses. Because some of the symptoms of flu and COVID-19 are similar, it may be **hard to tell the difference** between them **based on symptoms alone**.

WHO: The current ailment is part of ILI and has **identical symptoms of ILI**, which can kill up to 650000 people each year.

1. Cumulative Total deaths of Seasonal Influenza A in the country for the year 2019(till September) is 44 (NCDC Report).
2. Total ILI deaths = Covid deaths + 1 above. i.e 145000 approx.
3. Average ILI death in India per year is 150000 Approx.
4. Where is the increase in death?.
5. Also see next slide for ICMR Death Report card.

Herd Immunity

It is a biological fact.

The natural infection goes though all the layers of defense imitates robust response and keeps the immunological memory. Data from WHO and ICMR indicates huge Antibody positivity of cured people. Cell paper convincingly demonstrates Immunity Much before to other Cold CVs which offer response against current CV.

Infection Arithmetic (18.12.20)

Based on ICMR Publication

10004893 x 130 = 130 Crore are Infected, Upper end

10004893 x 82 Crore are Infected, Lower end.

Meaning 82 Crore to 130 Crore people are infected with the Virus

59 to 93% are infected with the virus in India

Logic of Calculation: For each case, 82 to 130 are infected as per survey.

We have Reached Herd Immunity

IJMR DOI:10.4103/ijmr.IJMR_4051_20

Heterogeneous populations develop herd immunity quicker.

India is a geographically large and diverse country with huge Young population who have much better immunity.

Even 40% infection could lead to herd immunity in case of Covid 19.(Science 369:846, 2020)

VACCINES

Vaccination is for the whole society while drugs to treat illnesses are for a small cohort of the sick at a given time. So, unlike pharmaceuticals, for which present illness drives demand, it is the **"perception of risk"** for disease that creates desire for vaccination.

Vaccination by Mother Nature

Cell paper **normal people from 2015 Immune to** SARS **CoV2 Echoed by VP of Pfizer**

Already We have Immune T cells to Current **CV (Many Publications)**

Has Nature Not Immunized us Against CV ? Through the Natural delivery route:

Your Nose Mouth

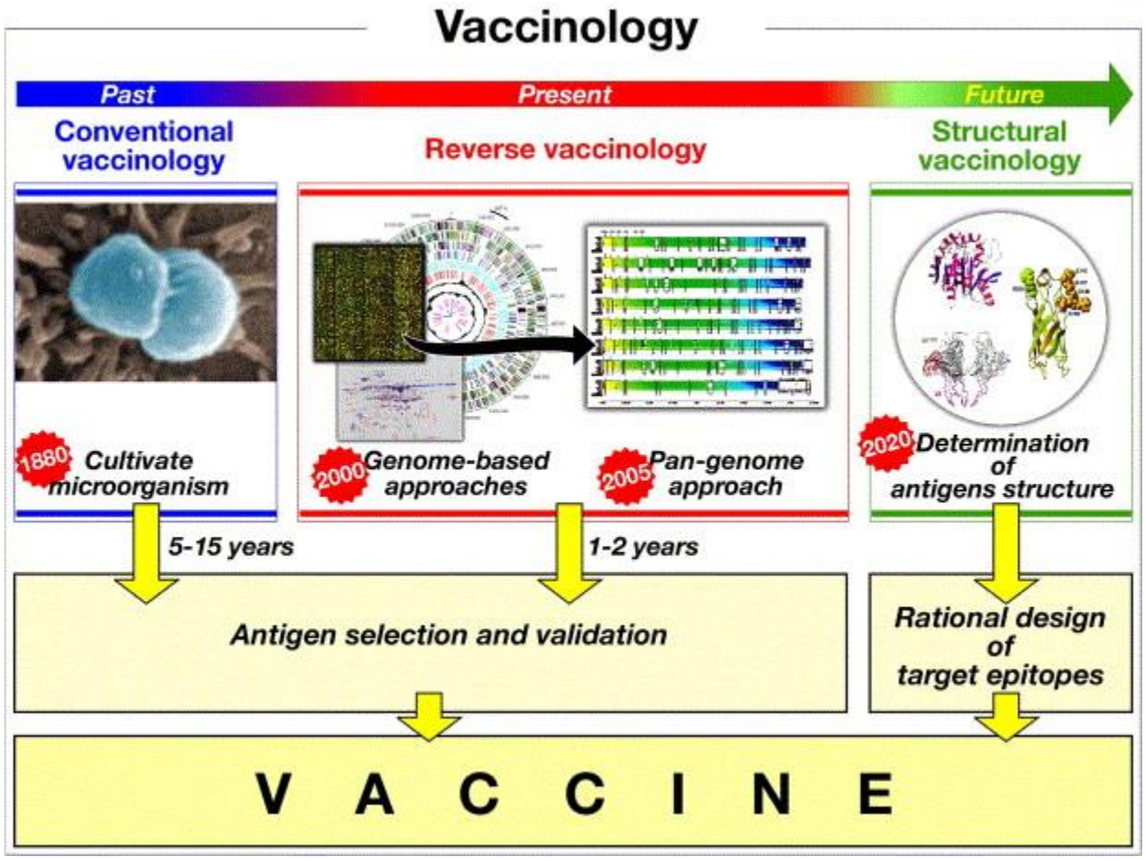
Nature /Vs Laboratory

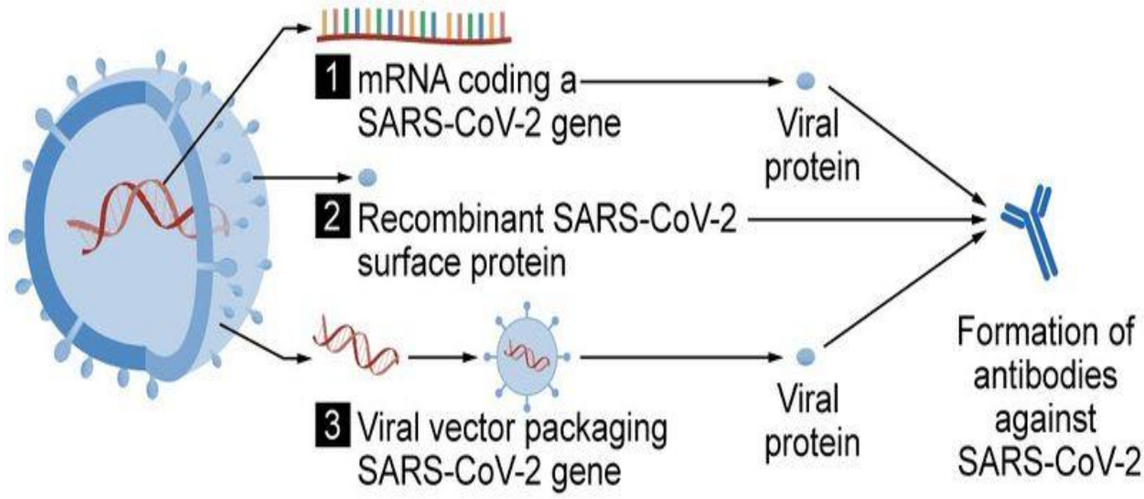
The current vaccination strategies undergoing clinical trials differ from natural infection in a variety of ways, including the method for generating or introducing viral antigens into the body, the site of exposure, and the presence of adjuvants

Science Immunology 22 Dec 2020:Vol. 5, Issue 54, eabf8891

DOII: 10.1126/sciimmunol.abf8891

Few examples of genuine reinfection across the millions of those who have tested positive for the virus globally. These virus specific memory B cells were stably present for 8 months after the infection. Memory for also Nucleocapsid protein and Spike protein.

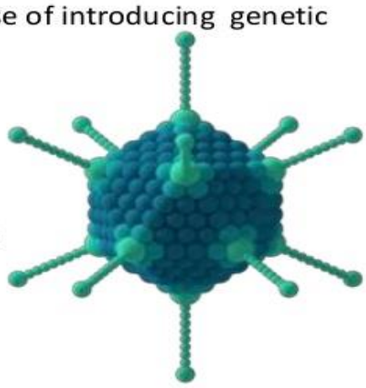




Source: GAO. | GAO-20-583SP

A viral vector is a virus which has been modified in a laboratory environment for purpose of introducing genetic material into a cell.

- To form a viral vector, **remove the genes in the virus that cause disease**.
- Then replace those genes with genes **encoding the desired effect** (for instance, insulin production in the case of diabetics)..



This procedure must be done in such a way that the genes which allow the virus to insert its genome into its host's genome are left intact

Astra/Oxford/Serum Vaccine Lancet Dec20: chimpanzee adenovirus vectored vaccine

vaccine efficacy	**Vaccine**	Control
✓ **62·1**%	27 / **4440(0.608%)** *vs* **71 / 4455(1.59%)**	

✓ **90**%Low dose + standard dose, 3/**1367** *vs* **30/1374**;

Number in Green is RTPCR + cases, in Red total Number

Safety and efficacy (interim analysis) of four trials

From control grou**p** 4455+1374= 5829

21 days after the first dose, two were classified as severe COVID-19**, including one death.**

Note: Controls were injected with not saline but

Meningococcal Vaccine which is not OK.

Questions of AstraZeneca Vaccine

Volunteers not screened for T cell Immune response to CV

No Participants with medical comorbidities . Very few from 70+

Control (Meningococcal vaccine or saline). Meningococcal vaccine is Known to Induce Anaphylactic Shock; This is not an appropriate control. Short and Long Dose confusion: Could be to minimize Immune response against the Adenovirus Vector?

Sputnik vaccine comprises two Adenovirus vector components, 21 days apart

This open-labelled, non-randomised study overestimate treatment effects with Sputnik V(influence of a doctor) only 39 cases (too low a number for an efficacy evaluation).Phase 3 interim report: They report an efficacy rate of over 90% in this group also, although no details of how these results were obtained .

Group	Number	Confirmed cases RT PCR	Rate %	Efficacy%
Vaccine	17032	16	0.094	(1.09-0.094)/1.09 **= 91.4%**
Placebo	5682	62	1.09	

Vaccine Efficiency

Body can mount immune response against Adenovirus. Glycosylation can influence antigenicity and immunogenicity of many viral glycoproteins (J virology 81:1821, 2007). This suggests RNA vaccine could have reduced immunogenicity.Sputnik uses different Virus for Challenge Dose- prevent Immune response

Excipients

Vaccine Ingredients: Fetal Bovine Serum, Chemical used for inactivation, Stabilizers, Adjuvant, Polyethyline glycol, preservatives should be made public. The inactivated virus is mixed with adjuvants — substances known to enhance immune response. In the case of Covaxin, the adjuvants used are alum and a molecule known as **imidazoquinoline,** which helps the body produce heightened response. Aluminium in adjuvant form carries a risk for autoimmunity, long-term brain inflammation and associated neurological complications and may thus have adverse health consequences. Curr Med Chem2011; 18(17):2630-7.

Natural Immunity lasts

Defining the features and duration of antibody responses to SARS-CoV-2 infection associated with disease severity and outcome, *Science Immunology* 07 Dec 2020: Vol. 5, Issue 54, eabe0240 DOI: 10.1126/sciimmunol.abe024

Vaccination Nature Vs Man made for SARS CoV2

Parameter	Nature	Manmade
No. Immunized	➢ Billion (Before, After Dec19) ➢ Herd Immunity in Place	<1000
Viral Antigen recognized	Many:	Just One
Cell Mediated Response	Very Good	Good

Antibody Response	Lasts > 8 months	Not done for >2 m
Route	Nose/Mouth	Muscle
Interaction with Immune	Robust	Not Robust
Allergy Autoimmunity	No	Observed
Unknnown health risk	No	Possible
Extraneous material	No	Many Excipients
Efficacy end point	RT PCR +, ARDS, Sepsis,	Minor symptoms, RTPCR +
Cost	Minimal	costly
Tested in	Yes	No
Children/Lactating Mother	Tested	Not tested
Aged >75	Tested	Not tested

References

1. A. Wajnberg *et al., Science* **Vol. 370, , pp. 1227-1230,2020 Science 369, 846–849 (2020** Robust neutralizing antibodies to SARS-CoV-2 infection persist for months.
2. **IJMR DOI:10.4103/ijmr.IJMR_4051_20**
3. **Even 40% infection could lead to herd immunity in case of Covid 19.(Science 369:846, 2020)**
4. Cell 181:1489, 2020
5. Science 370:1272 and 1339,2020
6. Natural vaccine from a circulating Coronavirus **Science 370:1272 and 1339,2020.** Intentional delivery of HCoV-229E may suppress infection rates and reduce the incidence of severe COVID-19 and spread
7. **Clinical Microbiol Reviews 9:18, 1996**
8. Defining the features and duration of antibody responses to SARS-CoV-2 infection associated with disease severity and outcome, *Science Immunology* 07 Dec 2020: Vol. 5, Issue 54, eabe0240 DOI: 10.1126/sciimmunol.abe024
9. Rapid generation of durable B cell memory to SARS-CoV-2 spike and nucleocapsid proteins in COVID-19 and convalescence
10. *Science Immunology* 22 Dec 2020: Vol. 5, Issue 54, eabf8891 DOII: 10.1126/sciimmunol.abf8891
11. hygiene covid National Centre for Cell Sciences, Pune, and Chennai Mathematical Institute.
12. Data from WHO CDC ICMR Health Ministry.