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INDEX

MAINSTORMING 2021

SCIENCE & TECHNOLOGY

(DECEMBER 2020 TO SEPTEMBER 2021)

1. SPACE

1.1 Missing Supermassive Black Hole

Why in news?

A supermassive black hole, which is estimated to weigh up to 100 billion times the mass of the Sun, is seemingly missing.

What is the finding?

- Scientists have been looking for the black hole using NASA's Chandra X-ray Observatory and Hubble Space Telescope.
- They have so far found no evidence that it is anywhere to be found.

Where is it supposed to be?

- The black hole is supposed to be located in Abell 2261.
    - Abell 2261 is an enormous galaxy cluster that is about 2.7 billion light-years away from the earth.
- One light-year is the distance that a beam of light travels in one Earth year, which is 9 trillion km.
- On the scale of the Universe, astronomers measure the distance from stars and galaxies in the time it takes for light to reach us.
- So, when we look at a celestial object, we are looking at how it appeared that long ago in the past.
- At 2.7 billion light-years away, the Abell galaxy is at an overwhelmingly large distance away from the earth.

What could have happened?

- Every large galaxy in the universe has a supermassive black hole at its centre, whose mass is millions or billions of times that of the Sun.
- The black hole at the centre of our galaxy, the Milky Way, is called Sagittarius A*, and is 26,000 light-years away from Earth.
- Scientists have been using data gathered in 1999 and 2004 to look for the centre of the Abell galaxy.
- But they have so far been unable to find its black hole.
- A reason for this could be that Abell's black hole has been ejected from the centre of the galaxy.
    - This is based on 2018 data from NASA's Chandra Observatory.
- This may have happened because of the merging of two smaller galaxies to form Abell.
- In the process, both of their black holes merged to form an even bigger black hole.

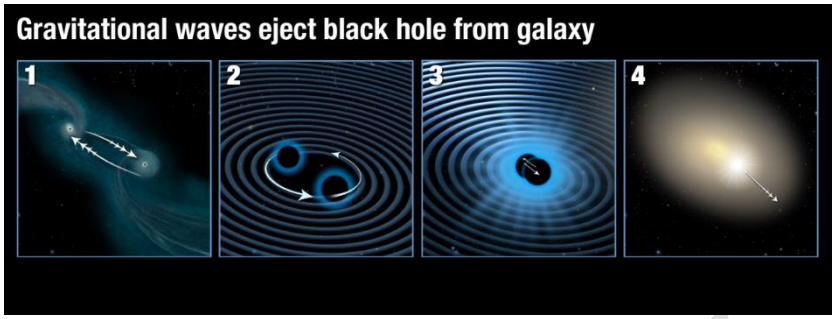
What is 'Recoiling' black holes?

- When two black holes merge, they release what are known as gravitational waves.
    - These are invisible ripples travelling at the speed of light, which squeeze and stretch anything in their path.
- During the merger, when the amount of waves generated in one direction is stronger than another, the new big black hole can be sent away from the centre of the galaxy into the opposite direction.
- This is known as a "recoiling" black hole.

What is the significance?

- So far, scientists are yet to find definitive evidence for recoiling black holes.

- They are yet to discover whether supermassive black holes can merge and release gravitational waves.
- As of now, only mergers of significantly smaller black holes have been verified.
- So, if the current hypothesis for Abell galaxy turns out to be true, it would mean a major breakthrough in astronomy.



1.2 Space Junk

Why in news?

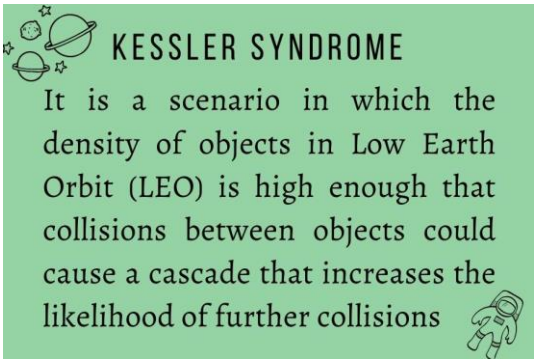
In March, a Chinese military satellite, Yunhai 1-02 collided with a piece of junk leftover from a 1996 Russian rocket launch leaving a trail of debris high above the Earth

What causes space junk?

- Unoperational / Expired / Exploded satellites, rocket parts or spacecrafts
- Anti-satellite tests that incapacitates or destroys *satellites* for strategic or tactical purposes (like **Mission Shakti** conducted by DRDO, China's 2007 ASAT test,etc.)
- Rare collision between two spacecrafts
- Mega-constellations of satellites planned by companies such as SpaceX 's **Starlinkprpject**

What are the threats posed by space junk?

- Collision of space debris with other satellites or amongst themselves produces more fragments and exacerbates the problem
- A belt of space junk would make certain low-Earth orbits unusable
- Experts have warned of **Kessler syndrome**
- Astronauts in space would be harmed by space debris
- Old batteries from defunct spacecrafts can explode and leaks may occur in the system
- The International Space Station (ISS) is constantly at risk from space debris



What has been done so far to manage the space junk?

- Orbital Debris Program Office was set up by NASA which issued the world's first set of debris-mitigation guidelines in 1995.
- it proposed that satellites be designed to re-enter Earth's atmosphere within 25 years of mission completion
- Europe plans ClearSpace-1, Earth's first space debris removal mission in 2025
- Researchers from Purdue University are test-launching a first-of-its-kind Spinnaker3 drag sail to low-earth orbit, in an effort to clean up space debris
- Japanese startupAstroscale launched a satellite that retrieves used satellites and other space junk
- In August 2020, **NETRA Project** was initiated by **ISRO** which is an early warning system to protect the satellites from space debris and other hazards of Space
- International Space Law points that if a satellite becomes dysfunctional, then the satellite should deorbit and its re-entry into the earth should be carried

What should be done?

- Updation of the **1967 Outer Space Treaty** which grants countries permanent property rights to their objects in space complicating the efforts to clean up debris

- Funding research into debris-removal technologies and partnerships with companies by NASA
- Expansion of Artemis Accords, a framework for space cooperation that includes (so far) 11 other countries by US

1.3 First Helicopter on Mars – Ingenuity

Why in news?

- NASA recently announced that Ingenuity had performed its first flight.
- The tiny helicopter Ingenuity took its first 40-second flight, ascending about 3 metres in the air.

What is Ingenuity?

- Ingenuity is the first helicopter to fly on Mars.
- It was carried by NASA's rover called Perseverance that was launched in July 2020.
- Ingenuity will help collect samples from the surface from locations where the rover cannot reach.
- **Features** - Ingenuity is able to fly using counter-rotating blades that spin at about 2,400 rpm.
- It has a wireless communication system, and is equipped with computers, navigation sensors, and two cameras.
- It is solar-powered, able to charge on its own.
- **Perseverance** landed at the Jezero Crater of Mars in February 2021.
- It will remain on the Red Planet for about 2 years and look for finding past signs of life.
- The rover is designed to -
  i. study signs of ancient life
  ii. collect samples that might be sent back to Earth during future missions
  iii. test new technology that might benefit future robotic and human missions to the planet

What were the challenges for the flight?

- It is an engineering challenge to fly on Mars.
- The atmosphere in Mars is 1% in density compared to the atmosphere on Earth.
- To sustain flight, the helicopter blades have to rotate at 2400 rpm (Rotations Per Minute).
- This is about 8 times as fast as a passenger helicopter to fly on Earth.
- For a helicopter to fly a few metres from the ground on Mars, is equivalent for a helicopter to fly 2-3 times the height of Mt Everest.
- The other challenge is to design a craft that will have its own power, communication and mechanical subsystems with such a small mass budget allocation.
- Ingenuity need to attend this high RPM and depend on solar panels for power.
- Besides this, it also had to survive the very cold Martian night [that can be brutal on batteries and the onboard computer].

Why is the mission so significant?

- This is the first flight of a powered aircraft on another planet.
- According to NASA, the helicopter was placed on the Martian surface to test, for the first time ever, powered flight in Mars's thin air.
- So the main task is to carry out a technology demonstration to test the first powered flight on Mars.
- Its performance during these experimental test flights will help inform decisions about small helicopters for future Mars missions.
- The helicopter's mission is experimental in nature and completely independent of the rover's science mission.
- Small helicopters can perform a support role as robotic scouts, surveying terrain from above, or as full standalone science craft carrying instrument payloads.
- Taking to the air would give scientists a new perspective on a region's geology.

- It would even allow them to peer into areas that are too steep or slippery to send a rover.
- In the distant future, they might even help astronauts explore Mars.
- NASA will try and demonstrate rotorcraft flight in the extremely thin atmosphere of Mars with this helicopter, which is why the mission is so crucial.
- Since the first flight has succeeded, the Ingenuity team will attempt up to four test flights within a 31-Earth-day window.
- Other technology demonstrations of the same kind include the Mars Pathfinder rover Sojourner and the Mars Cube One CubeSats that flew by Mars in 2018.

1.4 Muon g–2 Experiment - Challenging Known Laws of Physics

Why in news?

Newly published results of an international experiment (Muon g–2) suggest the possibility of new physics governing the laws of nature.

What is the recent finding?

- The experiment studied a subatomic particle called the **muon**.
- The results of the experiment do not match the predictions of the Standard Model.
- The Standard Model is that on which all particle physics is based.
- The results instead reconfirm a discrepancy that had been detected in an experiment 20 years previously.

What is the Standard Model?

- The Standard Model is a theory that predicts the behaviour of the building blocks of the universe.
- It lays out the rules for six types of quarks, six leptons, the Higgs boson, three fundamental forces, and how the subatomic particles behave under the influence of electromagnetic forces.
- The muon is one of the leptons. It is similar to the electron, but 200 times larger.
- It is much more unstable, surviving for a fraction of a second.

What is the Muon g–2 experiment about?

- The experiment, called Muon g–2 (g minus two), was conducted at the US Department of Energy's Fermi National Accelerator Laboratory (Fermilab).
- It measured a quantity relating to the muon.
- This followed up a previous experiment at Brookhaven National Laboratory, under the US Department of Energy.
- Concluded in 2001, the Brookhaven experiment came up with results that did not identically match predictions by the Standard Model.
- The Muon g–2 experiment measured this quantity with greater accuracy.
- It sought to find out whether the discrepancy would persist, or whether the new results would be closer to predictions.
- As it turned out, there was a discrepancy again, although smaller.

What was the quantity measured?

- It is called the **g–factor**, a measure that derives from the magnetic properties of the muon.
- As the muon is unstable, scientists study the effect it leaves behind on its surroundings.
- Muons act as if they have a tiny internal magnet.
- In a strong magnetic field, the direction of this magnet "wobbles," just like the axis of a spinning top.
- The rate at which the muon wobbles is described by the g-factor.
- This value is known to be close to 2.
- So scientists measure the deviation from 2; hence the name g–2 (g minus two).

How was it measured?

- The g-factor can be calculated precisely using the Standard Model.
- In the g–2 experiment, scientists measured it with high-precision instruments.
- They generated muons and got them to circulate in a large magnet.
- The muons also interacted with a "quantum foam" of subatomic particles "popping in and out of existence."
- These interactions affect the value of the g-factor, causing the muons to wobble slightly faster or slightly slower.

What do the recent findings mean?

- The results, while diverging from the Standard Model prediction, strongly agree with the Brookhaven results.
- The results from Brookhaven, and now Fermilab, hint at the existence of unknown interactions between the muon and the magnetic field.
- These are interactions that could possibly involve new particles or forces.
- To claim a discovery, scientists require results that diverge from the Standard Model by 5 standard deviations.
- The combined results from Fermilab and Brookhaven diverge by 4.2 standard deviations.
- While this may not be enough, it is very unlikely to be a fluke.
- In all, this is strong evidence that the muon is sensitive to something that is not in our best theory.
- The result thus suggests that there are forms of matter and energy vital to the nature and evolution of the cosmos that are not yet known to science.
- In other words, the physics now known could alone not explain the results measured.

1.5 NASA's Mars 2020 Perseverance Rover - Why is Mars so interesting?

What is the issue?

- NASA's Mars 2020 Perseverance Rover touched down on the Martian surface.
- In this context, here is a look at Perseverance Rover's plan and also why Mars remains so interesting for scientific experiments and exploration.

How had Mars Science been in the past?

- **1960s** - From the time of the first generation missions in the 1960s, the world has come a very long way in understanding Mars.
- The Viking missions in the mid-seventies carried out the first chemical analysis of Martian soil.
    - It also did four biology experiments to detect biological activity.
- The experiments did not yield any conclusive evidence of life.
- **1980s** - In the early 1980s, scientists hypothesised that certain meteorites might have a source region in Mars, in contrast to the asteroid belt.
    - This was based on mineralogic composition and rock texture.
- In 1984, a study showed that the isotopic composition of rare gases (Xenon, Krypton, Neon and Argon) matched the isotopic ratios of the Martian atmosphere measured by the Viking spacecraft.
- This discovery provided a way for geochemists to study Martian samples.
- It provided a huge boost to the understanding of the geochemical evolution of Mars.
- **2000s** - Mars was considered to be a dry planet in the 20th century.
- This changed in 2001, when the Gamma Ray Spectrometer on board the Mars Odyssey spacecraft detected a fascinating hydrogen signature.
    - It seemed to indicate the presence of water ice.
- But there was ambiguity, as hydrogen can be part of many other compounds as well, including organic compounds.
- To test for the presence of water, NASA sent a spacecraft to land near the Martian South Pole in 2007.

- The spacecraft studied the soil around the lander with its robotic arm.
- It was able to establish, without any ambiguity, the presence of water on Mars for the first time.
- The Curiosity rover carries an instrument called SAM (or Sample Analysis at Mars).
- It contains a suite of spectrometers with the goal of detecting organic compounds on Mars.
- SAM has a mass spectrometer that can measure not just the elements, but the isotopes as well.
- This instrument has made the fascinating discovery of large chain organic compounds on Mars.
- It is not known how these organics form on Mars.
    - The process would likely be inanimate.
    - But there is a possibility that such complex molecules were formed by processes associated with life.
- Mars Insight is creating history right now, by monitoring seismic activity and heat flow on Mars.
    - This will help understand the composition of the Martian interior.

Why is Mars so interesting to scientists?

- **First**, Mars is a planet where life may have evolved in the past.
- Conditions on early Mars roughly around 4 billion years ago were very similar to that of Earth.
- It had a thick atmosphere, which enabled the stability of water on the surface of Mars.
- If indeed conditions on Mars were similar to those on Earth, there is a real possibility that microscopic life evolved on Mars.
- **Second**, Mars is the only planet that humans can visit or inhabit in the long term.
- Venus and Mercury have extreme temperatures – the average temperature is greater than 400 degree C.
- All planets in the outer solar system starting with Jupiter are made of gas – not silicates or rocks – and are very cold.
- Mars is comparatively hospitable in terms of temperature, with an approximate range between 20 degrees C at the Equator to minus 125 degrees C at the poles.

Why is Perseverance Rover significant?

- Perseverance addresses both the critical themes around Mars:
    1. the search for life
    2. a human mission to Mars
- It is not just another Rover Mission but the most advanced, most expensive and most sophisticated mobile laboratory sent to Mars.
- The results of the experiments on Perseverance will likely define the next couple of decades of Mars exploration.
- It will determine the course of search for life and a future manned mission to Mars.

What all will the Perseverance Rover accomplish?

- **Sample Return Mission -** Perseverance is the first step in a multi-step project to bring samples back from Mars.
- The study of the returned rock samples will hopefully provide a decisive answer on whether life existed on Mars in the past.
- Here are the steps in the Sample Return:
    - Collect rock and soil samples in 43 cigar-sized tubes - samples will be collected, the canisters will be sealed, and left on the ground
    - Mars Fetch Rover (provided by the European Space Agency) - land, drive, and collect all samples from different locations, and return to the lander
    - The Fetch Rover will then transfer the canisters to the Ascent Vehicle.
    - The Mars Ascent Vehicle will meet with an Orbiter after which the Orbiter will carry the samples back to Earth.

- This long-term project is called MSR or Mars Sample Return.
- MSR will revolutionise our understanding of the evolutionary history of Mars.
- If MSR is successfully executed, it will tell a reasonable answer of whether there was microscopic life on Mars.
- But MSR does have its risks.
    - If one of the components fails, like the Fetch Rover or the Mars Ascent Vehicle, MSR is doomed.
    - A hidden risk is strategic. At the cost of MSR, there could be 5-10 spacecraft missions to different parts of the solar system.
- **Producing oxygen on Mars**: A technology and infrastructure in place to manufacture oxygen on Mars using raw materials available on Mars, is crucial to make a human mission to Mars at reasonable cost.
- Perseverance will have an instrument – MOXIE, or Mars Oxygen In-Situ Resource Utilisation Experiment.
- This will use 300 watts of power to produce about 10 grams of oxygen using atmospheric carbon dioxide.
- Should this experiment be successful, MOXIE can be scaled up by a factor of 100 to provide the two very critical needs of humans:
    - oxygen for breathing
    - rocket fuel for the trip back to Earth
- **Looking for underground water on Mars**: Perseverance will carry the Radar Imager for Mars' Subsurface Experiment (RIMFAX).
- RIMFAX will provide high resolution mapping of the subsurface structure at the landing site.
- The instrument will also look for subsurface water on Mars.
    - If found, it would greatly help the case for a human mission or the cause of a human settlement on Mars.
- **Testing a helicopter to fly on Mars**: The Mars Helicopter is really a small drone.
- It is a technology demonstration experiment, to test whether the helicopter can fly in the sparse atmosphere on Mars.
- The low density of the Martian atmosphere makes the odds of actually flying a helicopter or an aircraft on Mars very low.

1.6 Spectrum Auctions

Why in news?

Recently Department of Telecommunications announced that 4G spectrum auctions for different bands will begin from March 1, 2021.

What are spectrum auctions?

- Cellphones& wireline telephones require signals to connect from one end to another & they are carried through airwaves at designated frequencies to avoid any kind of interference.
- These airwaves are called spectrum which are subdivided into bands having varying frequencies & are owned by the union government.
- These airwaves are sold by Central government through auctions for a certain period of time (20 years) after which validity lapses.
- With the expansion in the number of cellphone, wireline telephone & internet users, more space is required for signals to come.
- Hence Central government auctions the airwaves to companies which are willing to set up required infrastructure to transport these waves from one end to another.

What is the history of spectrum auctions?

- Spectrum auctions were conducted since 2010 (except in 2015) but they are largely unsuccessful due to the high reserve price fixed by the telecom regulator.
- In 2012, 1800 MHz & 800 MHz bands which were put up for sale only a small percent of 1800 MHz band was sold & 800 MHz was unsold completely.

- This unsold spectrum & additional spectrum of 900 MHz band which were auctioned in 2013 but the prices did not change significantly.
- In the 2014 auction, spectrum prices for the 900 MHz and 1800 MHz bands in the metros were much higher than international average.
- In 2016, though the bids were invited for over 2000 MHz spectrum was fixed Rs 5.3-lakh crore, it received only Rs 65,789 crore.
- Nearly 60% of the airwaves put on the block did not find any takers & there was not a single bid for the 700 MHz band due to the high reserve price.

Why is spectrum being auctioned now?

- The last spectrum auction was held in 2016 & government offered 2,354.55 MHz at a reserve price of Rs 5.60 lakh crore.
- Government managed to sell only 965 MHz (40% of the spectrum put up for sale) & the total value of bids received was just Rs 65,789 crore.
- The validity of the airwaves bought by companies is set to expire in 2021 & there was a need for new spectrum auction.
- On March 1 government plans to sell spectrum for 4G in the 700, 800, 900, 1,800, 2,100, 2,300, and 2,500 MHz frequency bands.
- The reserve price of all these bands together has been fixed at Rs 3.92 lakh crore which can go up based on the demand.

Who are likely to bid for the spectrum?

- Private telecom players- Reliance Jio Infocomm, Bharti Airtel & Vi -are eligible to buy additional spectrum to support the users on their network.
- Apart from these three, foreign companies are also eligible to bid for the airwaves.
- However foreign companies have to either set up a branch in India & register as an Indian company or tie up with an Indian company to retain the airwaves after winning them.

What will the bidding cost the three existing companies?

- Bidders can either buy new spectrum or renew the old spectrum licences which they already have.
- Analysts expect that Bharti Airtel will renew some of its old spectrum & not bid for new spectrum.
- Vi may not participate in this auction as it faces constraints in cash flow.
- However Reliance Jio will renew its existing 44 MHz spectrum & bid for additional spectrum in the 55 MHz band.
- It will incur a total capital expenditure of Rs 240 billion at reserve prices & it has to make an upfront payment of nearly Rs 60 billion if it opts for the long term deferred payment plan.

How will the deferred payment plan work?

- As per this plan, bidders of sub-1 GHz bands 700, 800 and 900 MHz have to pay 25% of the bidding amount now & rest later.
- For the above-1 GHz bands of 1,800, 2,100, 2,300, and 2,500 MHz, bidders have to pay 50% upfront & rest can be paid in equated annual instalments.
- However successful bidders have to pay 3 % of Adjusted Gross Revenue (AGR) as spectrum usage charges excluding the wire line services.

What will the concern in the upcoming auctions?

- Though the final reserve price for 800 MHz spectrum is 18.5% lower than the 2016 price, the price for 1800 MHz & 2300 MHz is 14.5% and 17.5% higher respectively.
- The spectrum price for 700 MHz was cut by 43% still it remains very expensive.
- The operators need to spend nearly Rs 65,000 crore to own 10 MHz of spectrum pan-India.
- Hence none of the existing operators will be in a position to place such an expensive bet with a collective debt of Rs 5- lakh crore.

2. BIOTECHNOLOGY

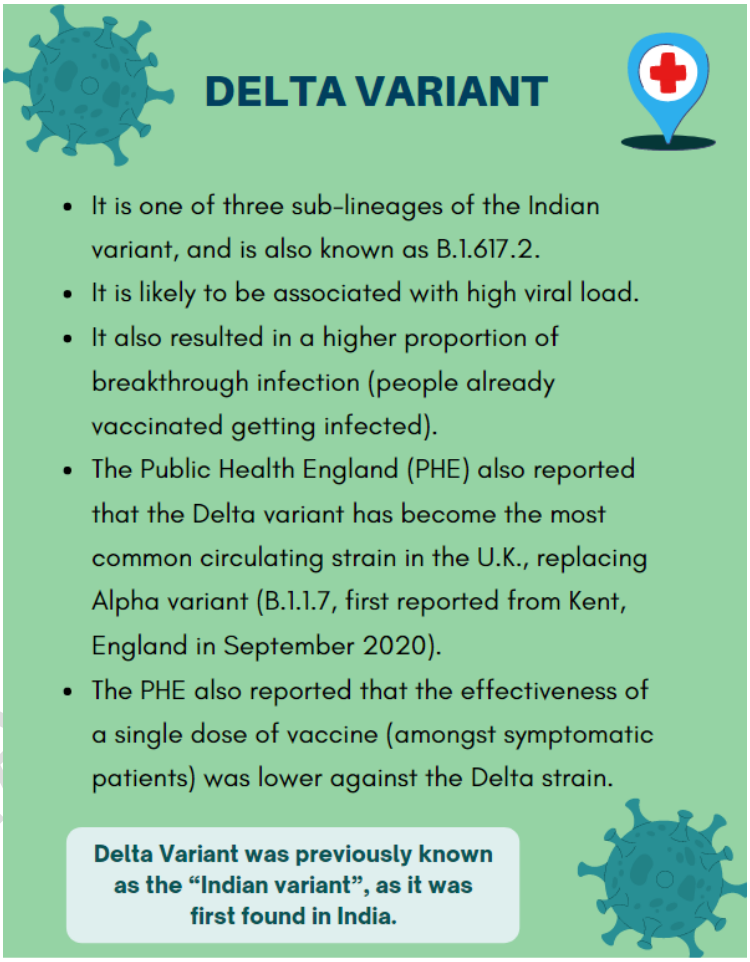
2.1 Genome sequencing in Pandemic Response

What is the issue?

- Emerging variants, with evidence of higher transmissibility and immune escape, demand re-strategised responses to COVID-19 pandemic in India.
- Genomic sequencing becomes significant in this context.

How does genome sequencing help?

- [Genome sequencing refers to figuring out the order of DNA nucleotides, or bases, in a genome - the order of As, Cs, Gs, and Ts that make up an organism's DNA.]
- An effective COVID-19 pandemic response includes keeping track of emerging variants.
- There are a total of 10 variants till now including variants of interest and concern.
- Conducting further studies about their transmissibility, immune escape and potential to cause severe disease is essential now.
- Therefore, genomic sequencing becomes one of the first steps in this important process.
- Besides increasing vaccination coverage, the U.S. and UK have scaled up genomic sequencing which went a long way in containing the virus.



What is the case with India?

- India seems to be faltering on both expanding vaccination coverage and genomic sequencing.
- Procedural steps such as setting up the Indian SARS-CoV2 Genomic Consortia, or INSACOG have been taken.
- But the sequencing has remained at a very low level of a few thousand cases only.

What are the measures to be taken?

- **Genomic sequencing**- India needs to scale up genomic sequencing, across all States.
- There should be sufficient and representative samples collected for genomic sequencing.
- This will help track district-level trends in circulating variants.
- A national-level analysis of collated genomic sequencing data should be done on a regular basis.
- And the findings should be shared publicly.
- **Research** - The government must invest and support more scientific and operational research on vaccine effectiveness.
- The data should include various stratifiers such as age, gender and comorbid conditions, etc.
- **Vaccine policy** - There are early indications of immune escape and reduced vaccine effectiveness against the *Delta variant* (especially after one shot).
- So, the policy on population coverage with two shots of vaccine, gap between the doses, priority groups, etc should be reviewed scientifically.

2.2 DNA Fingerprinting: Concerns in conviction of criminals

What is the issue?

Though DNA fingerprinting technology has helped in solving many crimes, its efficiency is being suspected in the conviction of criminals

What is DNA fingerprinting?

- It is a technique for identification of an individual by examining their DNA
- DNA or Deoxyribo Nucleic Acid is composed of bases, (adenine (A), cytosine (C), guanine (G), and thymine (T)) , sugar and phosphate
- Two bases link to each other using hydrogen bonds to form basepairs
- Though 99.7% of the makeup is similar between any two people there is a 0.3% difference which accounts to almost 10 million different base pairs
- By examining this we can identify the relation between two people
- Blood, semen ,hair and teeth (with roots), , bones, flesh, saliva etc. can be used to study the DNA

What are its uses?

- For criminal identification
- To resolve disputes of maternity /paternity
- To identify mutilated remains
- In cases of exchange of babies in hospital wards,
- In forensic wildlife
- Close to 60 countries have got the legislations on DNA profiling

Click here to learn about DNA Technology (Use and Application) Regulation Bill

What are the issues with DNA fingerprinting?

- **Ecological impacts** - Degradation of a sample with prolonged contact to sunlight, humidity, and heat
- **Unreliable results** - Instrumental errors also lead to unreliable results
- **Privacy issues -** Sensitive genetic information of a person is exposed to another individual and it is against human rights
- **Security concerns -** DNA databases holding DNA profiles
- **Lack of expertise -** Leads to mishandling of samples
- **Intermixing of samples** - Corruption, tampering with evidence, misconception during labeling sample is possible
- **Targeting of groups -** If people from one ethnic group are more often convicted, they will be overrepresented and leads to targeting

How to address these issues?

- Acceptance by the legal fraternity and ensuring 100% conviction rate
- Legal framework for innocents is needed to allude the fears of DNA profiling in data collection and maintenance
- Stringent implementation of Human DNA Profiling Bill
- Experts have clarified that DNA profiling will not give out any details of background or identity of religion.

2.3 Mapping the Genomes in the Indian Ocean

Why in news?

Recently, Scientists will expedite to Indian Ocean for a research project to explore the internal working of the Ocean at cellular level.

What is the research project about?

- The team of 30 scientists and researchers from NIO will traverse from India's east coast to Australia, Mauritius, borders of Pakistan and end in India's west coast.
- They will collect samples from various stretches of the ocean at an average depth of about 5 km.
- Using this data, scientists will do the genome mapping of microorganisms present in the Indian Ocean.
- This mapping is similar to gene mapping carried out on human's blood samples.

What are the outcomes of this mapping?

- One, the mapping will help in understanding the internal working of Indian Ocean ecosystem.
- This will identify the factors which control the changes in RNA, DNA in the oceans and various stresses which affects them.
- Two, the Indian Ocean has several micronutrients like nitrates, sulphates and silicates, minerals like iron ore and zinc, and trace metals like cadmium or copper.
- This mapping will help in understanding which microbes have adapted to these nutrients and will help in identifying which part of the ocean has a greater concentration of which mineral.
- It will also find out the cause for excess or lack of a certain minerals in the Ocean and suggest possible solutions for their mitigation.
- Three, the exploration will advance commercial biotechnology applications like anticancer treatments, cosmetics, industrial enzymes and antiviral molecule.
- Four, this will give new insights into their taxonomy and their adaptive capacity which helps in optimising the conservation efforts.

What can we infer from studying the interactions of trace metals and marine plant and animal life?

- Trace metals like cadmium or copper are essential for ocean productivity which are supplied to oceans via continental run-offs, atmospheric deposition, and hydrothermal activities.
- The interaction of trace metals with marine biota gives a holistic understanding about nutrient cycling and productivity of the oceans.
- Moreover, the isotopic forms of trace metals can be utilised to track the movement of water masses responsible for ocean circulation.
- From this we can understand the biological, geochemical and ecosystem processes and food web analyses.
- The project is also expected to generate new information about trace metals from underexplored regions of the Indian Ocean.

3. ROBOTICS AND COMPUTER

3.1 Google's Online Cloud Storage

Why in news?

From June 1, 2021 Google's online cloud storage policy will undergo a major change.

What is Google's existing policy?

- Regular Google Account Users will get 15GB of free storage space towards the user's Gmail, Drive and Photos.
- However, this free space is not counted for photos uploaded in Google Photos app.
- Usually, photos of higher resolution are compressed & saved without running out of space on the free account.

What are the new changes in the policy?

- From June 1, 2021, Google Photos will not be free & will be counted towards the account storage.
- Photos & videos of original resolution which are uploaded will not be affected as they are counted against the online storage available in your account.

Why Google is making this change?

- It says that people are uploading more content than ever before—more than 4.3 million GB are added across Gmail, Drive, and Photos every day.
- It needs to make these changes to keep pace with the growing demand.
- Further, users who are dependent on Google Photos will have to make payments for using its cloud service.
- Under its **Google One program**, it starts at 200GB for Rs 210 per month, 2TB for Rs 650 per month or Rs 6500 per year, 10TB at Rs 3,250 per month and 20TB at Rs 6,500 per month.

How will the existing users be affected?

- All photos and videos uploaded before June 1, 2021 will continue to remain free, will not be counted against the storage & won't be deleted.
- But all those uploaded post June 1, 2021 will be counted against the Google's free space.
- If more photos and videos uploaded, users have to pay for their services.
- However, existing paid Google One account users will not be affected by these changes.

Why is Google deleting content from inactive accounts?

- As per its new policy, Google will delete content from inactive accounts (accounts inactive for more than two years).
- Account can be kept active by periodically visiting Gmail, Google Photos and Google Drive.
- Those who are within their storage quota and in good-standing will not be affected.
- If the storage limit is exceeded for 2 years, content will be deleted. & Google will warn before it decides to delete.

3.2 Hybrid Cloud and the Remote Reality

Why in news ?

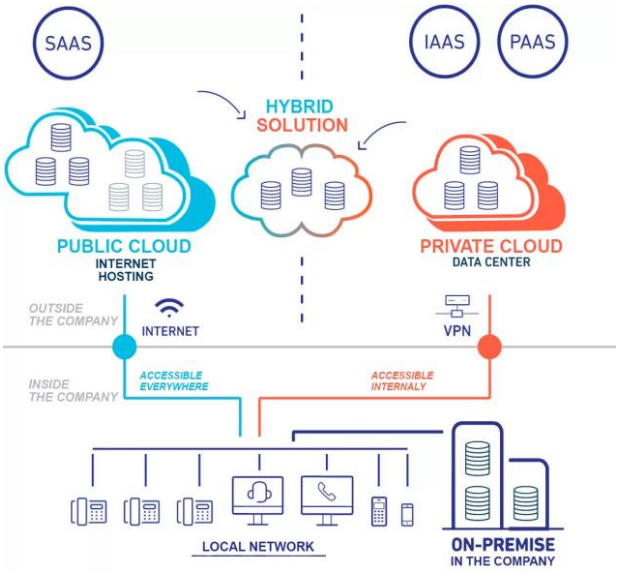
As businesses shift priorities to enable remote work, it's time to rely on an effective multi-cloud, multi-edge, hybrid approach

What is a hybrid cloud?

- Hybrid cloud is an IT infrastructure that combines and unifies public cloud and private cloud services from multiple cloud vendors.
- Hybrid cloud architecture focuses on the mechanics of transforming portions of a company's on-premises data centre into private cloud infrastructure
- It then connects that infrastructure to public cloud environments hosted off-premises by a public cloud providers such as Google Cloud Services, IBM Cloud, Microsoft Azure, etc.

What are the benefits of hybrid cloud platform?

- **High scalability -** With the scope of new additions in existing infrastructure
- **Very secure -** Giving businesses crucial control over their data and improved security
- **High flexibility -** Certain types of data can be stored on-premise while allowing less sensitive data to be stored on the cloud
- Greater infrastructure efficiency by strengthening remote work
- Cost and time efficient
- Modernisation of application landscape
- Seamless cross-functional communication
- Overall business acceleration



What parameters need to be assessed in this model?

- Regulatory requirements

- Security compliance
- Stringent latency
- Connectivity issues
- Dependency on internal IT infrastructure
- Managing multiple vendors and platforms

3.3 Hyperautomation - The Next Frontier

What is the issue?

- The global hyperautomation market is anticipated to grow at a CAGR (Compound annual growth rate) of 18.9% during 2020-27.
- In this context, here is a look at its features, scope and potentials.

What is hyperautomation?

- Conventional automation or Robotic Process Automation (RPA) performed rule-based tasks.
- RPA was a foundation stone that has made way for users to explore the broader meaning and greater abilities of automation.
- The last few years have seen the emergence and convergence of many powerful technologies related to artificial intelligence, machine learning, and intelligent and cognitive automation.
- The strategic confluence of these technologies is also known and defined as hyperautomation.
- One of the key differentiators of hyperautomation is its ability to loop humans into the process.

What are the key features of hyperautomation?

- **Artificial intelligence (AI)** - AI enables organisations to become Insight Driven Organisations (IDO).
- It relies on the fundamental building blocks of people, process, data and technology being in place and informed by an analytics strategy.
- **Advanced analytics** - The power of data is in its interpretation.
- Organisations that are able to leverage the full power of data and analytics will create unique and sustainable competitive advantage in their marketplace.
- **Intelligent automation** - This relates to leveraging a suite of tools and technologies that emulate and enhance human actions and capabilities.
- The objective is to create higher-than-normal value for the key stakeholders including shareholders, customers, employees and community.
- **Information management** - It is a business-driven approach to designing and implementing next generation solutions and processes.
- This supports businesses globally to better manage, protect, share and innovate with their data.

What is the future scope?

- Artificial intelligence, machine learning, and intelligent automation are amongst the top ten Industry 4.0 technologies.
- These may have the most profound impact on major organisations globally.
- Hyperautomation leverages new and combined capabilities to expand the frontiers of automation.
- Extensive digitalisation of traditional manufacturing plants will be the primary contributor to hyperautomation market.

What are the key potentials of hyperautomation?

- **Workforce enablement** - Hyperautomation helps organisations accelerate their digital transformation journey.
- Employees will be able to automate the many processes within their role, and get more done faster with the resources available to them [‘doing more with less’].

- Minimising manual tasks enables them to focus on more impactful work, like planning and strategy.
- **Employee upskilling** - Automation is no longer reliant solely on IT skills.
- A business user has thus the potential to become an automation thinker, influencer and leader.
- This could lead to a more hyper-skilled employee base that can achieve better outcomes than before.
- **Systems integration** - With hyperautomation, a company's old on-premise technology and disparate data systems can communicate seamlessly with the power of integrations.
- **Digital agility** - With many automation technologies, a company can move past the one-off benefits of a single technology to a state of true digital agility and flexibility at scale.
- In all, hyperautomation creates newer and better outcomes such as simpler processes, higher productivity and reliability, 'less stress' work environment, and more agile and flexible organisations.

3.4 India's Strengths in the era of Distributed Intelligence

What is the issue?

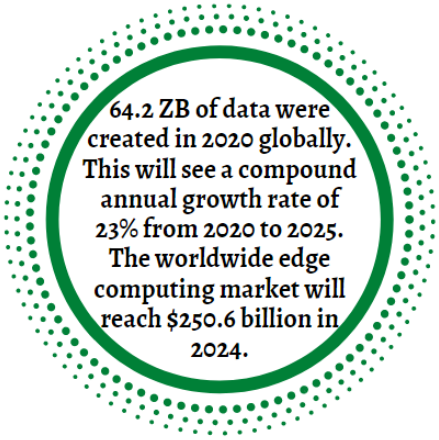
Computing is in its new era of distributed intelligence. Here is how India's prospects in this technological phaseare.

Top new technology trends

Artificial Intelligence (AI) and Machine Learning, Robotic Process Automation (RPA), Edge Computing, Quantum Computing, Virtual Reality and Augmented Reality, Blockchain, Internet of Things (IoT), 5G, Cyber Security

What is distributed intelligence?

- Distributed intelligence or distributed logic refers to **separating the processing** in a large system (centralised processor) into multiple subsystems.
- There is a surge in usage of new devices (computers, smartphones, IoT devices, sensors, etc) leading to exponential increase in data generation.
- Distributed intelligence thus helps in faster data computation as it takes computing back to the source of the data via edge computing.



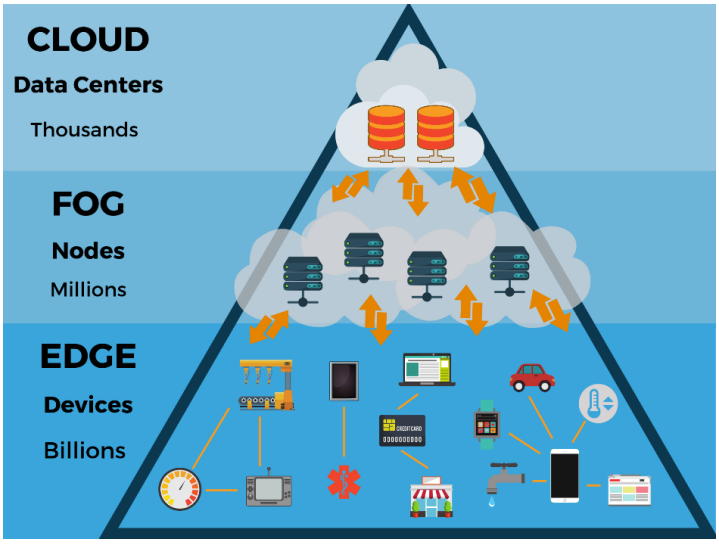
What is edge computing?

- Edge computing is a distributed information technology (IT) architecture.
- Data is processed at the periphery of the network, as close to the originating source as possible, instead of centralised processing.
- This enables faster processing bybypassing the bandwidth limitations, latency issues and unpredictable network disruptions caused by cloud computing.

What are India's strengths?

Large Population

- Amount of data being generated and processed is unmatched.
- Data generated can be used to provide detailed user insights for further growth and development.
- Population density also makes technology solutions scalable and resilient i.e., solutions designed for India, has ease of adaptation in any country.



Technological advantages

- Existing strengths in software, and an emerging hardware ecosystem.
- Innovative start-up community and abundance of talent.

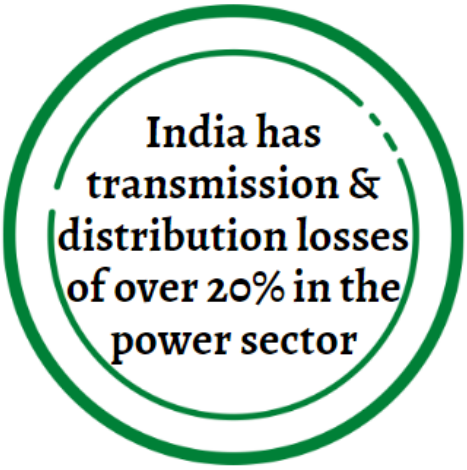
- The proliferation of AI and the upcoming 5G rollout.

Administrative support

- National Strategy on Artificial Intelligence by NITI Aayog
- Emerging Technologies division in the MeitY.

What are the areas of scope?

- **Power** - Smart Meter National Programme put distributed intelligence to use and enabled distributors to achieve 95% billing efficiency during the lockdown using smart meters.
- Once the solution is deployed, it will help the power sector minimize its transmission and distribution losses within a few years.
- **Retail sector -** To tackle consumers' fears for offline purchase amidst the pandemic, Amazon launched its Smart Stores programme in India.
- This turns retail stores into "digital storefronts" that allow smart and contactless product selections and payments.
- With distributed intelligence, the retail segment can look at flexible price adjustments, intelligent product recommendations, cashier-less payments, personalized products and services, etc.



- **Agriculture** - Key challenges are weather unpredictability and lack of crop diversification for better yields.
- Smart agriculture-as-a-service solutions involve use of smart sensors and other devices.
- This helps generate data to develop insights on weather and soil conditions, and manage processes from seeding to harvesting.
- **Healthcare** - Contactless continuous remote monitoring of patients in hospitals or homes.
- Patient data can be processed via edge computing to detect health deterioration and generate early warnings for timely medical intervention.
- **Education**-Distributed intelligence applications offer online services for students through mediums ranging from videos and flashcards to virtual reality enhanced by edge computing.

3.5 Crypto Currency

Why in news?

Recently, government said that a law will made to regulate crypto currencies for ending the ambiguities over their usage in India.

What is Crypto currency?

- It is a digital currency that is secured by cryptography, which makes it nearly impossible to counterfeit.
- Many crypto currencies are decentralized networks based on block chain technology.

What is their existing legal status?

- The government said that such currencies are not legal tender as they are highly volatile, can be used for illicit Internet transactions & are outside the ambit of state.
- In 2018, RBI sent a circular to banks directing them not to provide services for those trading in crypto currencies but this circular was set aside by the Supreme Court.
- Court found the circular to be disproportionate & also RBI could not prove that entities are adversely impacted by these crypto currency exchanges.

Is banning such currencies a right approach?

- Smart regulation is preferable, as a ban on something that is based on a technology of distributed ledger cannot be implemented for all practical purposes.
- Even in China, where cryptocurrencies have been banned & Internet is controlled, trading in cryptocurrencies has been low but not non-existent.

- In India, inter-ministerial committee in its study found that most countries opted for regulation but it recommended an outright ban.
- Interestingly it batted for an official digital currency and promoting its underlying block chain technology.
- Hence government must regulate such currencies rather than banning them.

3.6 5G Trials

Why in news?

Recently, Department of Telecommunications has allowed state-run and private telecoms to start trials for 5G technology.

What is 5G technology?

- 5G or fifth generation is the latest upgrade in the long-term evolution mobile broadband networks.
- It offers exponentially faster download and upload speeds, delivers multi-Gbps (giga bits per second) peak rates and has ultra-low latency.
- It mainly works in 3 bands, namely low, mid and high-frequency spectrum — all of which have their uses and limitations.

What are the various bands in the Spectrum?

- **Low band:** This spectrum has shown great promise in terms of coverage and speed of internet and data exchange and the maximum speed of this band is limited to 100 Mbps (Megabits per second).
- This means that telecoms can use and install it for commercial cell phone users who do not have specific demands for very high speed internet.
- **Mid-band:** This spectrum offers higher speeds compared to the low band but it has limitations in terms of coverage area and penetration of signals.
- Telecoms, which have taken the lead on 5G, have indicated that this band may be used by industries and specialised factory units.
- This is used to the build captive networks that can be moulded according to the needs of that particular industry.
- **High-band:** This spectrum offers the highest speed of all the three bands but it has extremely limited coverage and signal penetration strength.
- The internet speeds is tested to be as high as 20 Gbps, while, in most cases, the maximum internet data speed in 4G is recorded at 1 Gbps.

How are telecoms functioning in the market?

- Currently, the telecom market in India is left with only three private telecoms.
- Rest of the companies have surrendered due to the low returns on investments over the years.
- Apart from the private telecoms, two state-run companies, MTNL and Bharat Sanchar Nigam Limited (BSNL) have survived but they are too making losses.
- Earlier standing committee of Lok Sabha on Information Technology censured the government for certain reasons.
- This includes delays in approvals, inadequate availability of spectrum, high spectrum prices, poor development of use cases and low status of fiberisation among others.
- For this reason, the panel said that India could miss the 5G bus.

Why are the trials for 5G technology important?

- By conducting trials in a variety of circumstances (semi-urban and rural areas), telecoms will offer the new 5G technology as soon as possible.
- This will increase their average revenue per user and provides an opportunity to expand to the untapped market.
- Also, it is important for the government to roll out the new technology as soon as possible.

How 5G trials will be conducted?

- In the initial phase, the trials will be for 6 months, including a 2-month period for procurement and setting up of the equipment.

- In these 6 months, telecoms will be required to test their set up in urban areas, semi-urban areas as well as rural areas.
- During this period, they will be provided with experimental spectrum in various bands- mid-band of 3.2 GHz to 3.67 GHz, millimeter wave band of 24.25 GHz to 28.5 GHz, and others.

3.7 India & 5G

Why in news?

Parliamentary committee thinks that India may miss the roll out of 5G services as mentioned in the government's report.

What are the findings of parliamentary committee?

- It says that despite Department of Telecommunications (DoT) report that India is ready to roll out 5G as early as 2018 but there is little progress on the ground.
- Uncertainty in spectrum auctions, high reserve price of spectrum, inadequate development of test cases, low reach of optical fibre & deficient back-haul capacity are the causes for it.
- It also noted that reserve price for auction of 5G was one of the highest in the world which needs to be rationalised.
- The reserve price must take into account the per capita income of the country & reserve prices mandated by other countries.

What is the status of global countries are in implementing 5G?

- Globally, across 59 countries 118 telecom service providers have started deploying 5G networks and AT&T started its testing and deployment in early 2018.
- Verizon followed AT&T's path in expanding its 5G ultra-wide broadband services to 60 cities in the US.
- China has rolled out its 5Gservices which covers around 8 per cent of their population.
- But India is yet to give formal approvals for 5G testing despite all the 3 major private telecom players having submitted their applications as early as January 2020.
- Reliance Jio is ready to deploy 5G services and is waiting for a nod from the DoT and Bharti Airtel has successfully demonstrated its 5G service over a commercial network in Hyderabad.

Will India miss the 5G bus?

- Though the DoT said that 5G network will be rolled out in late 2021 or early 2022, it would mostly be only in very selected areas.
- Therefore India will continue to use 4G network for the coming 5-6 years.
- It finds that 2G, 3G, 4G deployments was late by 4 years, 10years & 7 years respectively & sufficient preparatory work has not been undertaken for launching of 5G services in India.
- By the time 5G covers 20% of the world population, it will exclude a major portion of India hence it is likely that India is going to miss on 5G opportunities after missing the 2G, 3G and 4G bus.
- The committee suggests that India must expedite its approvals process, sort out issues such as spectrum auction, back-haul capacity, price and user test cases to catch up with other countries.

4. INTELLETUAL PROPERTY RIGHTS

4.1 Wrong Patent Regime

What is the issue?

Despite the ongoing COVID-19 crises,intellectual property rulesis been a barrier for right to access healthcare.

How does patent rules function in India?

- There is a constant tension in offering exclusive rights over medicines and state's obligation of ensuring in equal access to basic healthcare.
- The colonial-era lawwhich allowed for pharmaceutical patents was changed when committee chaired by **N. RajagopalaAyyangar** in 1959 objected it on ethical grounds.

- It found that foreign corporations used patents to suppress competition from Indian entities and thus medicines were priced at high rates.
- **Patents Act, 1970** was enacted subsequently that removed the monopolies over pharmaceutical drugs, with protections offered only over claims to processes.
- This change in rule allowed generic manufacturers in India to grow and as a result life-saving drugs was available at affordable prices.
- This was affected when negotiations begun to create WTO which would give a binding set of rules governing intellectual property.
- It was also said thatcountries which fail to subscribe to the common laws of WTO will be barred in global trading circuit.

WHAT IS PATENT?

- A patent is a conferral by the state of an exclusive right to make, use sell an inventive product or process.
- Patent laws are usually justified on three distinct grounds:
  1. People have natural and moral right to claim control over their inventions;
  2. Exclusive licenses promote invention and benefit society;
  3. Individuals must be allowed to benefit from the fruits of their labour and merit;

- But with the advent of the **TRIPS agreement** in 1995 this concern was addressed and it was only after this Indian companies began to manufacture generic versions of medicines at low prices.

What is the problem now?

- Last year, India and South Africa requested WTOto temporarily suspendthe rules under the 1995 TRIPS agreement.
- A waiver was sought to the extent that the protections offered by TRIPS impinged on the containment and treatment of COVID-19.
- If waiver was allowed, countries will be in a position to facilitate a free exchange of know-how and technology surrounding the production of vaccines.
- But a small group of states — the U.S., the European Union, the U.K. and Canada among them —blocked the move.

Why these countries objected?

- These nations put forward two arguments for their objections which have been refuted time and again.
- One, that unless corporations are rewarded for their inventions, they would be unable to recoup amounts invested by them in research and development.
- Two, that without the right to monopolise production there will be no incentive to innovate.
- Recently, it has been reported that in U.S.Moderna vaccine was produced from the basic research conducted by the federal government agency and other publicly funded universities.
- Similarly, public money accounted for more than 97% of the funding towards the development of the Oxford/AstraZeneca vaccine.
- Therefore, the claim that a removal of patents would somehow invade on a company's ability to recoup costs is simply untrue.
- The second objection — the idea that patents are the only means available to promote innovation — has become a dogma.

What are the alternatives proposed?

- Under the current system, poor are unfortunate enough to have the disease and are forced to pay the price.
- Therefore a system that replaces patents with prizes will be more efficient and more equitable.
- Sovarious economists are proposing a prize fund for medical research in place of patents.
- This ensures incentives for research will flow from public funds while the biases associated with monopolies are removed.
- The pandemic has demonstrated how immoral the existing world order is which should not be allowed to persist.
- If nation states are to act as a force of good, they must attend to the demands of global justice.

4.2 Anti-disclosure amendment in the Patent Law

Why in news?

- Recently Union government published the Patent (Amendment) Rules, 2020 after a delay of almost two years.
- It has amended the format of the statement that patentees and licensees are required to annually submit to the Patent Office.

Why this disclosure is important?

- Patents are granted not only to encourage innovation but also to ensure that patentee has worked the invention in India.
- This can help to check abusive use of patent monopoly--excessive pricing or scare supply of the invention.
- This ensures that the benefit reach the public & is sufficiently available to them at reasonable prices.

What are the issues with existing rules?

- Patentees, licensees & Patent Office have ignored the disclosure requirement.

What are the existing patent rules?

- As per section 146(2) of patent law, every patentee/licensee is required to file an annual statement to the Indian Patent Office.
- It should disclose the information on the extent to which patentee worked the invention in India.
- It has to be as per Form 27 format prescribed under the Patent Rules, 2003.
- Any violation of these rules can trigger compulsory licensing or revoking the patent given under the Patents Act, 1970.

- Courts also refused to give an interim order in cases where there is infringement of a patent which has not been worked in India.
- There is also significant pressure from MNC's and the United States government to do away with this requirement.
- Hence a PIL was filed before the Delhi High Court in 2015 which brought to the Court's attention the rampant non-filing & defective filing of Form 27 by patentees/licensees.
- It sought direction to the government to strictly enforce the patent working disclosure rules & take action against the violators.
- It also called for a reform of Form 27 stating that the information it sought was insufficient to ascertain the extent of the working of the patent.
- The government gave an undertaking to the court to make appropriate amendments in the Form 27.

What are the new rules?

- The New form requires the patentees/licensees to provide only the following information:
  1. Whether the patent has been worked or not in India;
  2. If the invention has been worked, the revenue accrued in India from manufacturing &importing the invention into India;
  3. If it has not been worked, reasons for the same and the steps taken towards working in India;
- Now they need not provide any information in respect of the quantum of the invention manufactured/imported into India.
- Information w.r.t licenses & sub-licenses granted during the year and meeting of public requirement at a reasonable price is also not required.

What are the issues with new patent rules?

- The new rule removed lots of important information to be submitted in the form.
- Data on the total units of the invention manufactured/imported in India is essential to determine the extent to which it has been worked in India.

- However this data is not available as per new rules & patentees can just self-certify that they've worked the patent without providing appropriate claims on it.
- Disclosure of this data by Bayer in Form 27 played a crucial role in granting India's first compulsory license to Natco for the anti-cancer drug Sorafenib/Nexavar.
- PIL directed a mandatory disclosure of the following information:

1. Price of the invention;
2. Estimated demand, the extent to which the demand has been met;
3. Steps undertaken by the patentee to satisfy the demand.

- However the new rule does not disclose the above information.
- Hence it is difficult to ascertain whether the invention is available to the public in sufficient quantity & at affordable price.

What are the consequences of the new rules?

- The amended rules have damaged the core essence of the patent working requirement and the Form 27 format.
- The lack of required information can prevent invoking the compulsory licensing if patent abuse takes place or if critical inventions are inaccessible to the public.
- This can lead to adverse consequences for public health of the country.
- Hence government must reconsider its amendments to the form taking into account the PIL recommendations.
- It should re-amend it to restore as well as strengthen its spirit.

4.3 Patents and COVID

What is the issue?

Patents are restricting the access of essential technologies to many countries for providing early and affordable services to counter pandemic.

How patents are threat in combating the pandemic?

- No country is safe till every country is safe and a global threat of this magnitude needs a global thrust to counter it.
- Patents restrict access to essential technologies and reduce the ability of many countries to provide early and affordable services needed for an effective and equitable response.
- This is true not only of vaccines but also of several technologies for testing, treatment, prevention and personal protection.
- There is glaring disparities in access to each of these, at all stages of the pandemic.

Why patents should exist?

- Industries invest a lot of money into discovery and development of innovative products and therefore entitled to earn profits.
- This will also incentivise them to invest in fresh product development.
- It is stated that only certain industries had the expertise and experience to work with complex technologies and deliver products of assured quality and safety.
- These vaccine developers are located in high income countries.
- So they propose the idea of licensing to manufactures in low and middle income countries.

What does licensing imply?

- India supplies over 60% of the vaccines for the universal immunisation programmes for women and children.
- The alternative of licensing to the manufacturers in low- and middle-income countries is deceitful.
- Vaccine developers contract to large-scale manufacture only to reduce labour costs through cheaper hired help.

- Also, the terms of licensing contracts are often obscure, without clarity on level of vaccine access to the country which is making it, level of tiered pricing or the extent of profit sharing.
- Therefore, licensing with technology transfer and patent waivers are not mutually exclusive.
- Both can proceed apace and let more manufacturers gear up to protect the world against present or future pandemics.

What was India's approach earlier?

- It must be remembered that India moved from product patenting to process patenting in 1972.
- This gave the Indian pharmaceutical industry a huge boost where generic drugs were manufactured in large scale which helped the world to gain access to essential drugs.
- Cipla providing much needed anti-HIV drugs in Africa reflects the idea of global health equity.
- If India had succumbed to global pressures to protect patent rights, the story of Indian pharmaceutical industry would have been sadly very different.

What are the takeaways?

- It is well established that much of the foundational research that goes into drug and vaccine development in high income countries has been financed by public funding.
- This is done through research grants provided to universities and research laboratories.
- The scientists working in pharmaceutical companies of high-income countries were originally educated in low- and middle-income countries.
- Therefore, the world should benefit from collective intellectual collaboration not from restrictive barriers that lock innovation into patent prisons.

4.4 Intellectual Property Waiver for Vaccines

Why in news?

Recently, the U.S. government has said that it will support for the waiving Intellectual Property (IP) protection for Covid-19 vaccines.

What are Patents?

- A patent represents a powerful IP right and is an exclusive monopoly granted by a government to an inventor for a limited, pre-specified time.
- It provides an enforceable legal right to prevent others from copying the invention.
- Patents can be either process patents or product patents.
- A product patent ensures that the rights to the final product is protected and anyone other than the patent holder is restrained from manufacturing it during a specified period.
- This is applicable even in the cases if they were to use a different process.
- A process patent enables any person other than the patent holder to manufacture the patented product by modifying certain processes in the manufacturing exercise.

What does India follow?

- India moved from product patenting to process patenting in the 1970s, which enabled India to become a significant producer of generic drugs at global scale.
- Between 1972 and 2005, India had adopted process patenting rather than product patenting, and built up a huge generic industry.
- This allowed companies like Cipla to provide Africa with anti-HIV drugs in the 1990s.
- But due to obligations arising out of the TRIPS Agreement, India had to amend the Patents Act in 2005 and switch to a product patents regime across the pharma, chemicals, and biotech sectors.

What was the earlier proposal from India and South Africa?

- In October 2020, India and South Africa had asked the WTO to waive certain conditions of the TRIPS Agreement.

- This was related to the provisions in TRIPS that could impede timely access to affordable medical products to combat Covid-19 which includes – testing, diagnostics and novel therapeutics.
- They also asked for enforcement of four sections -1, 4, 5, and 7 -in the second part of the agreement which pertain to copyright and related rights, industrial designs, patents etc.
- The proposal said that developing countries are facing institutional and legal difficulties when using flexibilities available in the TRIPS Agreement.

What does IP waiver for Covid-19 vaccines mean?

- It will result in the production of Covid vaccines with emergency use authorisations (EUA) on a larger scale in middle-income countries.
- Currently most of the production is concentrated in high-income countries and production in the middle-income countries happens through licensing or technology transfer agreements.
- But the pharmaceutical companies say that ramping up the production capacities and it will take at least a few months.

What are the deterrents for the waiver?

- Earlier pharma companies opposed the proposed waiver saying that eliminating IP protections would undermine global response to the pandemic, including the ongoing efforts to tackle new variants.
- It could create confusion that could potentially undermine public confidence in vaccine safety and create a barrier to information sharing.
- They say that it would not be feasible for a company to move vaccines to a developing nation as these countries do not have the capacity to speedily produce vaccines.

What are the other roadblocks to scaling up production?

- The real challenges include trade barriers, bottlenecks in supply chains, scarcity of raw materials and ingredients in the supply chain & unwillingness of rich countries to share doses with poorer nations.
- The scarcity of raw materials has been a growing issue for ramping up production, several manufacturers have been relying on specific suppliers and alternatives are limited.
- Also, countries like the US had blocked exports of critical raw materials used in the production of some Covid-19 vaccines using regulations like the American Defence Production Act (DPA).
- This led to a delay in the production of Covid vaccines by some companies in India.
- In India, vaccine manufacturers said that the use of the DPA had blocked exports of plastic bags, filters and certain media used in the production of the version of Novavax vaccine.

4.5 TRIPS waiver

What is the issue?

The member countries of the WTO are under an obligation to ensure that their domestic IPR laws conform to the TRIPS agreement.

Why waiver is needed?

- When the pandemic hit the globe, India and South Africa proposed to waive key provisions of the TRIPS agreement on COVID-19 vaccines, drugs, therapeutics, and related technologies.
- This ensures that patents do not become barriers in scaling up production of medical products essential to combat COVID-19.
- The proposal is essential because it would give immunity to member countries from a legal challenge at the WTO if their domestic IPR laws do not enforce IP protection on COVID-19 medical products.

How Compulsory Licensing helps in waiver?

- It is uncertain when the TRIPS waiver would be adopted and what are the conditions it would be subjected to.
- So India can use the existing flexibilities under the **Patents Act of 1970,** such as compulsory licences.
- This is consistent with the TRIPS agreement and will increase the supply of COVID-19 medical products.
- Natco, an Indian pharmaceutical company, has requested a compulsory licence forBaricitinib, a COVID-19 drug.

- Incyte Holdings Corporation owns the patent for Baricitinib with a licence to Eli Lilly, an American drug company.

What are the problems in this?

- The government hasn't made use of compulsory licences in the pandemic.
- The Central government, in an affidavit filed before the Supreme Court says that issuance of compulsory licences will not be effective.
- It mentions that the main constraint in boosting the production of drugs like Remdesivir is the unavailability of raw materials and essential inputs which is a supply side issue and not the legal hurdle.
- Thus, the government believes that voluntary licences, not compulsory licences, is the way forward to address shortage of COVID-19 medical products.

What can be done now?

- The first step in advocating for the removal of IPR-related impediments is to use the existing lawful means to lift the obstacles that come in the way of manufacturing patented products domestically.
- Government can now use the Sections 92 and 100 of Patents Act to license all patents necessary to make COVID-19 medical products, without waiting for a private party to apply for a licence.
- This will have the advantage of forcing several pharmaceutical companies to offer licences voluntarily.

What more can be done?

- India has developed Covaxin with the taxpayers' money and the government has a stake in its IPR.
- Hence it should not only transfer Covaxin's technology to domestic pharmaceutical companies, to boost national supplies, but also offer it to foreign corporations.
- This will upkeep India's reputation of being the pharmacy of the world and also put pressure on developed countries to transfer their vaccine technology to developing countries.
- Also, India must take a consistent stand on IPRs on COVID-19 medical products internationally and domestically.

5. HEALTH

5.1 Malnutrition in India

What is the issue?

Data of various Nutritional indicators are expected to fall in the upcoming phase of NFHS-5 due the COVID-19 pandemic.

Why it is expected to fall?

- Three deficits significantly account for the fall in the data- dietary deficit, information deficit, inequitable market conditions.
- Apart from this, loss of livelihoods, reduced food consumption among the poor & disruption of government nutrition programmes are seen as other factors.

What does dietary deficit indicate?

- It is found among at least 40 % of our population of all age groups.
- This data is substantiated by the reports of the National Nutrition Monitoring Bureau's Third Repeat Survey (2012), NFHS 4, 2015-16, the NNMB Technical Report Number 27, 2017.
- The NHHS-4 and NFHS-5 survey reveals that acute dietary deficit exists among infants below two years & stunting and wasting exist for the infants below six months.
- This is caused either by foetal malnutrition or maternal dietary deficit because current interventions are not focussing the protein-calorie-micronutrient deficit.

What does information deficit indicate?

- Information deficit exists at the household level, especially among lower-income families.

- National IEC (information, education and communication) programme is not available to reach targeted households in order to make the required behavioural change.
- This includes the importance of balanced diets in low-income household budgets, proper maternal, child and adolescent nutrition and healthcare.
- Though IEC and behavioural change is highlighted in all our early Five-Year Plans but successive governments fail to make it happen.

What do inequitable market conditions reflect?

- This account for major cause of dietary deficiency and India's chronic malnutrition.
- Inequitable market conditions deny affordable & energy-fortified food to children, adolescents & adults in lower-income families.
- Though market has lots of expensive fortified energy food &beverages, it is not affordable for low-income groups except non-nutritive junk that cost about Rs 5.
- A study conducted by Karnataka Multi-sectoral Nutrition Pilot Project in 2018 reflects that there is a market demand of 42 million tonnes of low-cost energy food per year.
- And it is possible to produce nutritive fortified energy food for children within Rs 5 which can have 380 calories but no private entrepreneur provides it.
- It also says that there is direct relation between high incidence of stunting and wasting among children, low BMI among adolescents & the lack of low-cost fortified food.

What are the issues with current nutritional interventions?

- National Nutrition Policy 1993 is not updated in accordance with the latest surveys and research findings & interventions are not prioritised with respect to the current facts.
- Budgetary allocations for healthcare are insufficient & ICDS and its monitoring systems are not upgraded.
- The current programmes are not effectively targeting the root causes of malnutrition.
- Unless there is a disease outbreak efforts are not taken to address malnutrition & government intervenes only during disease outbreak.

What can be the future course of action?

- Government should analyse current nutrition-related programmes & find out why it is not able to reduce malnutrition faster.
- Highly malnourished districts have to be identified & additional interventions should be made in these areas.
- Government should show seriousness & start addressing this issue urgently through new ideas and innovations.
- Raising the diet of people from subsistence level to high level of nourishment will improve the nutritional indicator among children, adolescents and adults.
- Government/civil society should provide IEC to the community about malnutrition, its causes & implement programmes to address them.

5.2 Rethinking the Nutrition agenda

Why in news?

The Ministry of Health and Family Welfare released the findings of Phase I of National Family Health Survey-5 (NFHS-5) of 22 States/ UTs.

What is the result of the findings?

- Prevalence of severe acute malnutrition has increased in 16 States/UTs when compared to NFHS-4 excepting in Kerala and Karnataka.
- The percentage of children under five who are underweight has increased in 16 out of the 22 States/UTs.
- Anaemia levels have increased in most of the States among children & adult women.
- Lakshadweep, Andaman & Nicobar Islands, Dadra & Nagar Haveli and Daman & Diu & Meghalaya are the only exception states.
- BMI is less than 18.5kg/m2 in many States/ UTs indicating the prevalence of adult malnutrition.

- There is an increase in overweight/obesity prevalence among children and adults in most States/UTs.
- Childhood stunting is increased in 13 of 22 States/UTs when compared to NFHS-4.
- Sikkim, Manipur, Bihar and Assam have shown some improvement though they are behind their targets.
- The stunting among children under five has decreased from 48% to 38% between NFHS-3 & NFHS-4.

What do we infer from this data?

- This indicates there is inadequacy of diets in terms of quality and quantity.
- Nutritional intervention programmes needs to be introspected as childhood stunting is likely to increase.
- World Health Organization calls stunting "a marker of inequalities in human development".
- There exists underfunding in social protection schemes-MGNREGA, PDS, ICDS.
- Ministry of Women & Child Development data says only 32.5% of the funds are utilised for Poshan Abhiyaan in 2017-18.

How the Pandemic has has aggravated this problem?

- Recent survey by 'Hunger Watch' showed that massive levels of food insecurity exist among poor and vulnerable households.
- There is decline in food consumption among them.
- Two-third of the respondents reported that the nutritional quality and quantity of their diets worsened in this lockdown.
- However, we can witness some positive trends w.r.t. access to sanitation, clean cooking fuels & improvement in women status.

What needs to be done?

- Direct interventions such as supplementary nutrition of good quality including eggs, fruits, etc. needs to be strengthened.
- More resources need to be allocated for growth monitoring, behaviour change communication through the ICDS.
- Progress has to be made in enabling exclusive breastfeeding, appropriate infant and young child feeding.
- Women's unpaid work has to be recognised.
- Household food security, access to basic health services & equitable gender relations should no longer be ignored.
- It is essential to have employment-centred growth strategy including access to education, health, food & social security services.
- NFHS-5 should serve as a wake-up call & commitment to address the issue of malnutrition has to be made.

5.3 State of Food Security and Nutrition Report

What is the issue?

- The latest edition of the State of Food Security and Nutrition in the World (SOFI) report was recently released jointly by five UN organisations.
- It highlights the shortfalls on part of the government to handle the pandemic, which has led to increase in the prevalence of hunger and food insecurity.

What are the highlights of the report?

- India was home to the largest number of undernourished people in the world even before the Covid-19 pandemic.
- The prevalence of moderate to severe food insecurity in India rose by about 6.8 percentage points in 2018-20.
- In absolute terms, the number of persons facing moderate to severe food insecurity has increased by about 9.7 crore since the outbreak of Covid.
- Ironically, this happened when the government had an unprecedented 100 million tonnes of food grains in its godowns.

- This is larger than the food stocks of any other country.
- To state, the country with the largest stock of grain in the world [120 million tonnes as of July 1, 2021] accounts for a quarter of the world's food-insecure population.
- Globally, in 2020, over 237 crore people were grappling with food insecurity, which is an increase of about 32 crores from 2019.
- South Asia alone accounts for 36% of global food insecurity.

What are the key indicators used?

- Estimates on food insecurity presented in the SOFI report are based on two globally-accepted indicators of food insecurity:
    1. The Prevalence of Undernourishment (PoU)
    2. The Prevalence of Moderate and Severe Food Insecurity (PMSFI)
- **PoU** - The PoU estimates the proportion of people suffering from chronic deficiency of calories.
- The PoU estimates are based on estimates of per-capita supply of food and distributional parameters estimated using the national consumption surveys.
- **PMSFI** - On the other hand, the PMSFI is a more recently developed experience-based indicator.
- The PMSFI estimates are based on data collected through surveys that attempt to capture people's experiences of food insecurity.
- These include eating less, modifying diet to eat cheaper food, skipping meals, and eating less than adequate food because of lack of money or other resources.
- Since the outbreak of the pandemic, the Indian government has not undertaken any official assessment of food insecurity in the country.
- So, the PMSFI estimates are the only national-level valid and reliable estimates available on the pandemic's impact on food insecurity in India.
- PMSFI estimates show that there were about 43 crores of moderate to severe food-insecure people in India in 2019.
- As a result of the pandemic-related disruptions, this increased to 52 crores in one year.
- In terms of prevalence rates, moderate to severe food insecurity increased from about 31.6% in 2019 to 38.4% in 2021.

What are the reasons behind?

- Despite being self-sufficient in the production of major food commodities, India faces problems of hunger and food insecurity.
- This is because of widespread economic distress, high unemployment and high levels of inequality.
- A large proportion of the poor is dependent on the informal economy in which incomes are too low and uncertain.
- They do not have assured access to adequate and nutritious food.
- Unemployment rates too have risen sharply over the last few years.
- High (and fluctuating) food prices, shrinking public investment and the economic slowdown have added to the distress among working classes and the peasantry.
- These longstanding problems were aggravated in the recent year because of lack of preparation to deal with the pandemic.

What is needed now?

- With almost 120 million tonnes of grain currently lying with the government, it requires almost no additional resources.
- The need now is for the government to establish systems for regular monitoring of the food security situation in the country.
- It should also consider universalising access to the public distribution system, at least during the pandemic.

5.4 India's Disabled Population

Why in news?

December 3 is recognised by UN as International day of Persons with Disabilities.

Who are disabled people & how are they identified?

- In India, men are more disabled when compared to women & disability is more prevalent in rural areas than in urban areas.
- Locomotor disability is the most common disability & more men experience it than women.
- Disabled people are identified based on questions posed in census.
- The number of disabilities in the questionnaire was expanded from 7 to 21 with the enactment of **Rights of People with Disabilities** (RPwD) in 2016.
- Hence, 2019 report includes questions to identify people with temporary loss of an ability, neurological, blood disorders and acid attack victims as disabilities.

How does statistical data about them varies?

- As per the 2011 census, 2.2% of India's population lives with some kind of physical or mental disability.
- The latest 2019 NSO report, which used the expanded definition of disability reported a slightly higher prevalence.
- In 2019 study by the Public Health Foundation of India which used Annual Health Survey's metrics gives a lower prevalence.
- Similarly, a group of doctors from AIIMS found that alternate questionnaires like the Rapid Assessment of Disability have resulted in a prevalence ranging from 1.6%-43.3%.

Why do we need the exact data about number of disabled people?

- In India, disabled people enjoy benefits ranging from reservation in educational institutes to concessions on railway tickets.
- To claim these benefits, they have to furnish disability certificate.
- Moreover data on the prevalence and type of disability will be useful in making allocations for welfare schemes.
- The 2021 census will have disability questions as per the RPwD Act of 2016 & department of disability affairs is in the process of creating a national database of PwDs.

5.5 Indian Pharma Industry - Need for Innovation Focus

What is the issue?

Despite being a leading player, the Indian pharma industry needs a relook in the age of innovation and emerging challenges.

How significant is the Indian pharma industry?

- Leads in the global generic world.
- Indian pharmaceutical market is estimated at $40 billion.
- Pharma companies export another $20 billion.

> "India has more than 30% share in the global generic market but less than 1% share in the new molecular entity space"

What are the shortcomings?

- India's pharma industry is just a miniscule portion of the $1.27-trillion global pharmaceutical market.
- It ranks third worldwide for pharmaceutical production by volume, but only 14th by value.
- India is only the 12th largest exporter of medical goods.

What are the priorities now?

- Changing perspective and increasing the use of technology.
- Going beyond generics.

- Focusing on innovation.
- Creating and developing breakthrough products for Indian pharma companies to have a dominant global presence.

How significant is innovation in pharma industry?

- Bring new solutions to unmet healthcare needs.
- Reduction in disease burden through development of drugs for India-specific concerns like TB and leprosy.
- Creation of new high-skilled jobs.
- Facilitate probably around $10 billion of additional exports from 2030.
- Create a source of sustainable revenues.
- Stay relevant in the global pharmaceutical space. Countries like China have already leapfrogged ahead, skipping the generic chapter altogether.

What are the limitations?

- **Complex and delayed approval processes** - Nod for development of new drugs in India takes 33-63 months versus 11-18 months in developed countries.
- **Lack of robust process guidelines** - Indian websites list 24 guidelines compared to over 600 at the U.S. Food and Drug Administration.
- **Lack of transparency** - The US has an established pre-submission process and a time bound stage-gate process.
- **Inadequate capacity**/capability across regulatory bodies in India.
- **Limited governance** - Indian authorities currently only track the number of applications and approvals.
- **Limited innovation mindset** - India is risk averse compared to most global bodies. E.g., in the approval of clinical trials.

What are the measures to be taken?

- An enabling regulatory structure with simplified processes, robust guidelines, predictability, increased capacity and strong governance. India needs a 60% reduction in the approval timeline to be competitive.
- Funding support through policies/incentives, direct government investment, and significant Private Equity/Venture Capital investment.
- [The 'Make in India' campaign has played a small positive role in this regard.]
- Offering an attractive set of benefits for countries looking for innovation - Weighted R&D deduction, additional patent box benefits, progressive policies to increase innovation funding.
- Strong linkages between academia and industry, industry-oriented research.
- E.g., The US created the Bayh-Dole Act encouraging academics to set up independent companies.
- World-class centres of excellence to attract global talent and support cutting-edge research.
- A favourable policy landscape across research, technology commercialization and Intellectual Property.
- Innovation hubs to accelerate collaboration - Co-locating academia, public R&D centres, industry, start-ups and incubators.
- Policy support by way of R&D tax breaks, patent law tweaks and research talent.

5.6 Adulteration in Honey

Why in news?

The study by Centre of Science and Environment reveals that Indian brands of honey are adulterated.

What are the contaminants in honey?

- Honey is widely used as immunity booster & prophylactic (preventing the spread of disease).
- Now, they are adulterated with cheap sugar syrup imported from China, pesticides and antibiotics.
- Antibiotics such as terramycin & oxytetracycline are often used to treat bee-related disease.

- This has raised concerns over the quality of products.

What is status of Bee Industry in India?

- According to the Ministry of Agriculture in 2017-18, India ranks 8th in the world (China being No 1) in production and 5th as an exporter.
- Around 4 lakh people are involved in beekeeping producing 90 to 95 thousand tonnes of honey every year from 34 lakh bee colonies.
- India has a potential of about 200 million bee colonies as against 3.4 million bee colonies today.

What is the potential of Apiculture Industry?

- It has the capability to support incomes with low initial investment (10 bee boxes per beneficiary, each costing about Rs 5000, yields annual income of Rs 30000).
- Exporting about half its output yields a profit of Rs 7,000 crore annually.
- Increasing the number of bee colonies will not only increase the production of bee-related products but will boost overall agricultural and horticultural productivity**.**

What are the steps taken by government to boost apiculture?

- **Bibek Debroy** led committee has made recommendations to enhance the contribution of beekeeping sector for achieving the target of doubling the farmer incomes by 2022.
- **Sweet Kranti mission** was introduced in May 2017 to boost honey production.
- **National Beekeeping and Honey Mission** (NBHM) scheme was approved to promote & develop beekeeping in scientific way and to increase production of quality honey & other beehive products.
- Government is considering giving the status of farmers to landless beekeepers.
- The process of beekeeping from the farm to the processing stage needs to be reformed to expand consumption & export of honey.
- India must raise its bar on testing, apply the best technologies, and integrate beekeeping with organic farming initiatives, which will bolster its economic viability.

5.7 Antimicrobial Resistance

What is the issue?

Antimicrobial resistance is growing exponentially and is becoming a global health and development threat.

What is the Antimicrobial resistance?

- Antibiotic resistance (AMR) occurs when germs like bacteria and fungi develop the ability to defeat the drugs designed to kill them.
- Globally, about 35% of common human infections have become resistant to available medicines.
- About 700,000 people die every year because antimicrobial drugs are becoming less effective to combat pathogens.
- India being the largest consumer of antibiotics in the world, AMR is a serious problem.
- According to **The Lancet** study, in India approximately 58,000 new-born children die annually from sepsis because antimicrobial drugs are becoming less effective.

Why AMR occurs?

- Human activity has significantly accelerated the process of microorganisms developing resistance to antimicrobial agents.
- The misuse and overuse of antimicrobials for humans, livestock and agriculture is seen as cause for AMR.
- Water is seen as major mode for the spread of AMR, especially in places with inadequate water supply, sanitation and hygiene.
- India has a capacity to treat only about 37% of the sewage generated annually & rest is discharged into natural water bodies without treatment.
- The release of untreated effluents from households, health, pharmaceutical facilities and agricultural run-off is propagating resistant microorganisms.

What are the initiatives taken to combat AMR?

- UNEP in its 2017 **Frontiers Report**, identified AMR as one of six emerging issues of environmental concern.
- In 2017, the UN Environment Assembly advocated for understanding the role of environmental pollution in spreading AMR.
- UN agencies are working together to develop the **One Health AMR Global Action Plan** that addresses the issue in human, animal, and plant health and food and environment sectors.
- In 2020, MoEF&CC issued draft standards which sets the residue limits of 121 antibiotics to be released from drug production units.
- Governments need to factor in new research before it is becoming a threat to human & environment.

5.8 Antimicrobial Resistance: the silent threat

What is the issue?

- Antimicrobial resistance (AMR) is one of the greatest challenges of the 21st century.
- Tackling the problem calls for engaging the health, agricultural, trade and environment sectors; here is a look at the various aspects of it.

What is AMR and how serious it is?

- Antimicrobial resistance is the phenomenon by which bacteria and fungi evolve and become resistant (drug resistance) to presently available medical treatment.
- AMR is said to be a slow tsunami that threatens to undo a century of medical progress.
- It is already responsible for up to 7,00,000 deaths a year.
- Unless urgent measures are taken to address this threat, the world could soon face an unprecedented health and economic crisis.
- It could lead to 10 million annual deaths and cost up to $100 trillion by 2050.

How does drug resistance develop?

- Drug resistance in microbes emerges for several reasons including -
  i. the misuse of antimicrobials in medicine
  ii. inappropriate use in agriculture
  iii. contamination around pharmaceutical manufacturing sites where untreated waste releases large amounts of active antimicrobials into the environment
- All of these drive the evolution of resistance in microbes.
- This is compounded by the serious challenge that no new classes of antibiotics have made it to the market in the last three decades.
  - This is due to inadequate incentives for their development and production.
- A recent study found that over 95% of antibiotics in development today are from small companies.
- And 75% of this have no products currently in the market.
- Major pharmaceutical companies have largely abandoned innovation in this space.

What are the implications?

- AMR represents an existential threat to modern medicine.
- It could lead to a condition without functional antimicrobials to treat bacterial and fungal infections.
- So, even the most common surgical procedures, as well as cancer chemotherapy, will become fraught with risk from untreatable infections.
- Neonatal and maternal mortality will increase.
- All these effects will be felt globally, but the scenario in the low- and middle-income countries (LMICs) of Asia and Africa is even more serious.
- LMICs have significantly driven down mortality using cheap and easily available antimicrobials.

- In the absence of new therapies, health systems in these countries are at severe risk of being overrun by untreatable infectious diseases.

What does this call for?

- Tackling these diverse challenges requires action in a range of area.
- In addition to developing new antimicrobials, infection-control measures can reduce antibiotic use.
- A mix of incentives and sanctions would encourage appropriate clinical use.
- At the same time, it is critical to ensure that all those who need an antimicrobial have access to it.
- 5.7 million people worldwide die annually because they cannot access drugs for infections that are treatable.
- Further, to track the spread of resistance in microbes, surveillance measures to identify these organisms need to expand beyond hospitals.
- It should encompass livestock, wastewater and farm run-offs.
- Also, microbes will inevitably continue to evolve and become resistant even to new antimicrobials.
- So, there is a need for sustained investments and global coordination to detect and combat new resistant strains on an ongoing basis.
- There is the critical role of manufacturing and environmental contamination in spreading AMR through pharmaceutical waste.
- So, there is a need to look into laws such as those recently proposed by India, one of the largest manufacturers of pharmaceuticals.
    - The law aims to curb the amount of active antibiotics released in pharmaceutical waste.

What is the need for caution?

- Various countries are taking measures at individual an coordinated level.
- The range of initiatives that seek to control the emergence and spread of AMR is welcome.
- But, there is a need to recognise the limitations of a siloed approach.
- Current initiatives largely target individual issues related to AMR (such as the absence of new antibiotics, inappropriate prescription and environmental contamination).
- Thus they focus narrowly defined groups of stakeholders (providers, patients and pharmaceutical companies).
- Regulating clinician prescription of antimicrobials alone would do little in settings where -
    - patient demand is high
    - antimicrobials are freely available over-the-counter in practice, as is the case in many LMICs

What should the approach be?

- Efforts to control prescription through provider incentives should be accompanied by efforts to educate consumers.
- This will help -
    - reduce inappropriate demand
    - issue standard treatment guidelines that would empower providers to stand up to such demands
    - provide point-of-care diagnostics to aid clinical decision-making
- Policy alignment is also needed much beyond the health system.
- Solutions in clinical medicine must be integrated with improved surveillance of AMR in agriculture, animal health and the environment.
- In all, successful policies in individual countries are no guarantee of global success.
- International alignment and coordination are paramount in both policymaking and its implementation.
- Indeed, recent papers have proposed using the Paris Agreement as a blueprint for developing a similar global approach to tackling AMR.

5.9 Telehealth can help India

Why in news?

WHO in its July 2020 survey across 105 countries revealed that essential medical services got disrupted in the majority of countries.

What does the report say?

- Immunisation, antenatal and childcare services are the most widely affected services among them.
- 45% of low-income countries incurred at least partial disruption of over 75% of services whereas it is 4% in high-income countries & in South East Asia, 60% of services were got partially disrupted.
- In India, detection of TB cases was down by 50% in April-December of 2020 relative to the same period in 2019 and antenatal care visits were down by 56% in the first half of 2020.
- With stoppage of routine follow ups, blood sugar control for diabetics is at risk & Cancer care has been badly affected in many countries.

How can technology help in combating this issue?

- During the pandemic, E Sanjeevani platform offered provider-to-patient and provider-to-provider interactions, where patients visit Smartphone-equipped community health officers.
- They in turn connect to general practitioners and specialist through a hub-and-spoke model & this approach can be applied to deliver other health care services.
- In remotely shared medical appointments (SMA), multiple patients with similar medical needs meet with clinicians at once who receive individual attention which will increase telehealth capacity.
- This method is successfully adopted in the United States for over 20 years.
- SMAs enable peer support, peer-to-peer learning which can improve both productivity and outcomes for many conditions, notably diabetes.
- The Aravind Eye Hospital in Puducherry has successfully trialled in-person SMAs for patients with glaucoma and found that patients engage more and ask more questions.
- E-Sanjeevani and other telehealth platforms could offer such virtual shared medical appointments.
- Moreover this will help in building supportive bonds, enable sharing of local knowledge which can attract supplementary providers (physiotherapists, optometrists).

What are the challenges in it?

- Switching to radically different care delivery models requires rigorous testing combined with mentoring, training and behaviour change for both patients and providers.
- Adoption of in-person shared medical appointments has been slow.
- ECHO which train primary-care providers through an online can accelerate this model of care.

5.10 'One Health' Approach

What is the issue?

The battle against COVID-19 should be used as an opportunity to meet India's 'One Health' targets.

What is the "One Health" approach?

- The approach that acknowledges the interconnectedness of animals, humans, and the environment is referred to as "One Health".
- The father of modern pathology, Rudolf Virchow, emphasised in 1856 that there are essentially no dividing lines between animal and human medicine.
- Studies indicate that more than two-thirds of existing and emerging infectious diseases are zoonotic.
- In other case, they can be transferred between animals and humans, and vice versa, when the pathogen in question originates in any life form but circumvents the species barrier.
- Another category of diseases, "anthropozoonotic" infections, gets transferred from humans to animals.

What is the significance now?

- The transboundary impact of viral outbreaks in recent yearshas further reinforced the need to consistently document the linkages between the environment, animals, and human health.
- These include the Nipah virus, Ebola, Severe Acute Respiratory Syndrome (SARS), Middle East Respiratory Syndrome (MERS) and Avian Influenza.
- This concept is ever more salient now as the world continues to grapple with the COVID-19 pandemic.

What is India's framework for "One Health"?

- **Framework** - India's 'One Health' vision derives its blueprint from the agreement between the tripartite-plus alliance comprising –
  i. the Food and Agriculture Organization of the United Nations (FAO)
  ii. the World Organisation for Animal Health (OIE)
  iii. the World Health Organization (WHO) (and)
  iv. the United Nations Environment Programme (UNEP)
- It is a global initiative supported by the UNICEF and the World Bank under the overarching goal of contributing to 'One World, One Health'.
- **Initiatives** - In keeping with the long-term objectives, India established a National Standing Committee on Zoonoses as far back as the 1980s.
- Recently, funds were sanctioned for setting up a 'Centre for One Health' at Nagpur.
- Further, the Department of Animal Husbandry and Dairying (DAHD) has launched several schemes to mitigate the prevalence of animal diseases since 2015.
- The funding pattern works along the lines of 60:40 (Centre: State), 90:10 for the Northeastern States, and 100% funding for Union Territories.
- Under the National Animal Disease Control Programme, around Rs. 13,000 crore have been sanctioned for Foot and Mouth disease and Brucellosis control
- In addition, DAHD will soon establish a 'One Health' unit within the Ministry.
- Additionally, the government is working to revamp programmes that focus on –
  - capacity building for veterinarians
  - upgrading the animal health diagnostic system such as Assistance to States for Control of Animal Diseases (ASCAD)
- In the revised component of assistance to States/UTs, there is increased focus on vaccination against livestock diseases and backyard poultry.
- To this end, assistance will be extended to State biological production units and disease diagnostic laboratories.
- **Rabies** - WHO estimates that rabies (also a zoonotic disease) costs the global economy approximately $6 billion annually.
- Considering that 97% of human rabies cases in India are attributed to dogs, interventions for disease management in dogs are considered crucial.
- DAHD has partnered with the Ministry of Health and Family Welfare in the National Action Plan for Eliminating Dog Mediated Rabies.
- This initiative is geared towards sustained mass dog vaccinations and public education to render the country free of rabies.

What is the impending challenge?

- Scientific observations suggest that there are more than 1.7 million viruses circulating in wildlife.
- Many of them are likely to be zoonotic.
- This implies that unless there is timely detection, India risks facing many more pandemics in times to come.
- To achieve targets under the 'One Health' vision, efforts are ongoing to address challenges pertaining to –
  i. veterinary manpower shortages

ii. the lack of information sharing between human and animal health institutions

iii. inadequate coordination on food safety at slaughter, distribution, and retail facilities

5.11 Avian influenza Outbreak

Why in news?

After India declared itself free from avian influenza 3 months earlier, new cases of avian influenza subtypes have been reported now.

Where are the cases reported?

- Four States — Rajasthan, Madhya Pradesh, Himachal Pradesh, and Kerala -are the epicenters in this outbreak.
- In Haryana, Jharkhand & Gujarat, thousands of poultry birds have died but the cause of death is still unknown.
- The two subtypes (H5N1 & H5N8) have targeted different birds — crows in Rajasthan & Madhya Pradesh, migratory birds in Himachal Pradesh, and poultry in Kerala.
- H5N1 has caused the deaths of over 2,000 migratory birds in Himachal Pradesh.
- H5N8 led to the death of thousands of poultry in Kerala, hundreds of crows in Rajasthan and Madhya Pradesh.

How did the virus transmit?

- Migratory birds have been largely responsible for long-distance transmission of the virus into India.
- It also spreads through the local movement of residential birds and poultry.
- Movement of men and material from poultry farms too has been a cause for further spread.

What are the measures undertaken to control the outbreak?

- On Wednesday over 69,000 birds, including ducks and chickens, were culled in Alappuzha & Kottayam as per India's 2015 National Avian Influenza Plan.
- Other States have been asked to be vigilant of any unusual deaths or disease outbreak signs amongst birds, particularly migratory ones.
- States have been asked to strengthen bio security of poultry farms, disinfection and proper disposal of dead birds.

How was the global outbreak?

- As per European Food Safety Authority 561 avian influenza were reported in 15 European countries and the U.K between August-December.
- H5N1 and H5N8 were two of three subtypes found in Europe & it was predominantly found in wild birds, and a few in poultry and captive birds.
- Genetic analysis confirmed that spread from Asia to west-central Europe likely to cause persistent circulation of this virus strain in wild birds in Asia.

Does it transmit to humans?

- Though avian influenza virus cross the species barrier and occasionally infecting humans, but human-to-human spread is reported rarely.
- Mutations of an avian influenza A virus and a human influenza A virus in a person can create a new influenza A virus.
- This can result in sustained transmission between humans thus increasing the risk of a pandemic influenza.
- Hence efforts should be taken to control the outbreaks & genome sequencing of virus samples helps in tracking the evolution of the virus.

5.12 Focusing on Diseases Sidelined by COVID-19

What is the issue?

With increasing focus on COVID-19, non-communicable diseases and other health issues have been neglected which are adding a burden to the healthcare system

Why are non-communicable diseases burdensome?

- Nearly 71% of all deaths worldwide occur due to non-communicable diseases (NCDs) with cardiovascular diseases as the top cause.
- Premature loss of life due to NCDs in the age group of 30-69 years is very high among Indians.
- Among NCDs, persons with diabetes are at higher risk of severe clinical outcomes of COVID-19 such as mucormycosis

What disruptions have been caused due to the pandemic?

- Disruption of services such as primary healthcare system, Maternal healthcare services, Immunisation, Health surveillance, Screening and management of NCDs etc.
- Shortage of medicines, diagnostics and technologies
- Reassigning of staffs working in the area of NCDs
- Loneliness due to reduced physical interactions resulted in mental health disorders such as anxiety and depression.

What steps have been taken to address the issue?

- Setting up of National Programme for Prevention and Control of Cancer, Diabetes, Cardiovascular disease and Stroke (NPCDCS) to increase awareness on risk factors, to set up cardiac care units and to carry out screening at primary health care levels.
- Integration of NPCDCS with the National Health Mission (NHM) and AYUSH
- Use of applications such as mDiabetes for diabetes control, mCessation to help for quit tobacco, and no more tension as a support for mental stress management.
- India is the first country to adopt the National Action Plan in response to WHO Global Action Plan for the Prevention and Control of NCDs 2013-2020

- **Sustainable Development Goals**,2015 aims to reduce premature deaths from NCDs by one third by 2030

What should be done?

- Tobacco cessation must be included in NCD services such as in their national COVID-19 preparedness and response plans
- Telemedicine facilities should be promoted
- Equal weightage has to be provided for NCDs by the policymakers
- NGOs can be utilised in campaigning, delivery of medical services, etc.
- ASHA workers can be incentivised to ramp up the screening of NCDs at grassroot level
- Physical activity and mental health has to be prioritised
- Primary health system must be strengthened

5.13 Water and Virus

Why in news?

Recently NITI Aayog reported that over 70% of India's contaminated surface and groundwater is likely to carry virus.

How can water transmit virus?

- Today animals are locked together for mass production of meat which creates an artificial environment for mutations in erstwhile dormant viruses.
- These viruses can proliferate in wastewater and remnants of such virus are detected in raw sewage across Sydney.
- In England, Wales and Scotland, several wastewater samples carry traces of SARS-CoV-2.

- This water is often discharged into Indian water bodies and there is a high chance that these water bodies can be the host for viruses of different kinds on which they can mutate and strike.
- Water-transmitted viral pathogens are astrovirus, hepatitis A and norovirus can affect huge section of Indian population.
- This is because Indian people use polluted water from sources like rivers, lakes or groundwater for drinking.

What are the measures taken?

- Despite the poor water quality in India, Nal se Jal scheme was announced to provide drinking water connections to every rural household by 2024.
- Decontaminating Indian water bodies and groundwater could take several decades.
- Reverse osmosis technique can purify decontaminated water but it takes out all the healthy minerals required for the human body.
- Though ultraviolet aqua guard treatment neutralises the virus and doesn't remove minerals it is a costlier process to adopt.

What is the solution?

- There are two unpolluted fresh water sources left in the country.
- One is the water lying below our forests and other is the aquifers that lie below the floodplains of rivers.
- Both these sources provide natural underground storage of water which is renewable.
- These aquifers can be used to provide healthy mineral water for drinking purposes to our cities and towns and Yamuna floodplains in Delhi provide water to a million people each year.
- Hence these forests and floodplains must be declared as water sanctuaries.

5.14 Indian Coronavirus Variant of Global Concern

Why in news?

The World Health Organization (WHO) has classified a coronavirus variant first identified in Indiaas a "global variant of concern".

What is the variant?

- Indian variant**B.1.617** and its family of related coronaviruses have been categorised as a Variant of Concern (VOC) by the WHO.
- B.1.617 was classified as a variant under investigation (VUI) by authorities in the UK earlier in May 2021.
- They requested India to send samples of the B.1.617 strain to carry out wider studies on it and determine how effective existing vaccines are against it.

VARIANT OF INTEREST (VOI)

The US Centers for Disease Control and Prevention (CDC) defines a variant of interest (VOI) as a variant with –

i. specific genetic markers that have been associated with changes to receptor binding,
ii. reduced neutralization by antibodies generated against previous infection or vaccination,
iii. reduced efficacy of treatments, potential diagnostic impact, (or)
iv. predicted increase in transmissibility or disease severity

Usually, in countries that detect emergent variants, it is the health authorities there who flag them as potential VOC.

- While there are several so-called 'variants of interest' (VOI), only three, other than the B.1.617, have been categorised as VOC:
  1. the U.K. variant (B.1.1.7)
  2. the South Africa variant (B.1.351)
  3. the Brazilian variant (P2)

How are variants classified?

- **India** - Unlike the US's CDC or Public Health England, India still does not have a classification criterion for labelling viruses as variants of interest, or concern.
- It was in early April that this variant became formally classified as a lineage, B.1.617.
- It was only after the U.K.'s labelling it as a VOC that it was called so by health authorities in India.

How do variants of a virus emerge and why?

- Variants of a virus have one or more mutations that differentiate it from the other variants that are in circulation.
- While most mutations are deleterious for the virus, some make it easier for the virus to survive.
- Essentially, the goal of the virus is to reach a stage where it can cohabitate with humans because it needs a host to survive.
- This means, any virus is likely to become less severe as it keeps evolving.
- But, in this process, it can attain some mutations that may be able to escape the body's immune response or become more transmissible.
- The SARS-CoV-2 virus is evolving fast because of the scale at which it has infected people around the world.

VARIANT OF CONCERN (VOC)

As per WHO, a variant of interest (VOI) becomes a variant of concern (VOC) if, it has been demonstrated to be associated with –

i.increase in transmissibility,
ii.detrimental change in COVID-19 epidemiology,
iii.increase in virulence,
iv.change in clinical disease presentation, (or)
v.a decrease in effectiveness of public health and social measures or available diagnostics, vaccines, therapeutics

Alternatively, a variant may be classified as a VOC by WHO in consultation with the WHO SARS-CoV-2 Evolution Working Group.

- High levels of circulation mean it is easier for the virus to change as it is able to replicate faster.

What is the case with B.1.617 variant?

- The B.1.617 variant of the virus has two mutations referred to as E484Q and L452R.
- Both are separately found in many other coronavirus variants, but they have been reported together for the first time in India.
- The L452R mutation has been found in some other VOIs such as B.1.427/ B.1.429.
- These are believed to be more transmissible and may be able to override neutralising antibodies.
- The WHO has said that laboratory studies suggest that samples from individuals who had natural infection may have reduced neutralisation against variants which have the E484Q mutation.

Is B.1.617 the reason for the current surge in India?

- Indian government recently said that this variant also called the "double mutant variant" could be linked to a surge in the cases of coronavirus seen in some states.
    - In March 2021, nearly 20% of the cases from Maharashtra (consistently been among the most afflicted States) were being linked to the variant.
- This admission was a change in the Centre's previous stance.
    - Earlier it had said that the strain was not identified in enough samples to establish a sufficient link to the current surge.
- Even so, the government now said that the link was not "fully established".

Why are classifying variants significant?

- Based on the prevalence, some variants may go on to become the dominant strain in a region or multiple geographies.
- So, vaccine companies have to check whether their vaccines continue to be effective. Such studies have already begun in India.
- Even some of the emerging variants do seem to be better at evading antibodies.
- So, along with monitoring reinfections, classifying variants must be seen as a crucial health response.

5.15 3rd ICMR Serological Survey

Why in news?

Recently ICMR has released its 3rd serological survey to ascertain the spread of COVID-19.

What does the survey report?

- It shows that nearly one in five Indians — about 270 million — may have been infected & there has been a three-fold rise in infections when compared to the 2nd serological survey.
- There has also been a five-fold rise (in percentage terms) of the infection in those aged 10-17 years & 3rd edition includes a serological survey of doctors, nurses, and paramedical staff.
- This reveals that nearly 25% of this composition are infected which is significantly above the national average.
- It emphasizes that a significant proportion of people are still potentially vulnerable, underscoring the need to be vaccinated and continue with social distancing and use of masks.

What does this survey vary from other surveys?

- ICMR survey-results appear to be more conservative in estimating the true spread of disease when compared to city-focused serology surveys in Delhi and mathematical modelling estimates.
- Experts say that there is declining trend in infections since September and there is absence of multiple peaks in corona virus cases and speeding up herd immunity.
- But neither ICMR survey nor city-wide survey evaluated how long antibodies persist and if certain virus mutant variants can overcome the protection from antibodies.

What are the concerns in the survey?

- It is now no longer useful to know that 80% of India is still vulnerable given that vaccines are available.
- Rather, such surveys must shift focus on certain questions- rise in spread among teenagers and children mean that they must be vaccinated earlier than the scheduled time.
- It should focus on whether companies should accelerate trials to test protection in children and rise in cases in rural India mean that they be given vaccines earlier.
- ICMR and the government health facilities must coordinate with a broader spectrum of specialists to investigate on these questions which can be used to guide and modify vaccination policy.

5.16 COVID-19's Triage Challenge

Why in news?

Recently second COVID-19 wave has hit India with great ferocity.

How COVID second wave has affected health system?

- There is a shortage of beds, hospitals are flooded with patients and ambulances are screaming through the streets.
- There are curfews and lockdowns and death is in the air -a larger proportion of the elite has been infected.
- In Mumbai, high-rises (elites) have been more affected than slums.
- These elites now got exposed to the dysfunctionality of the healthcare system which the poor have endured for years.
- There is imbalance between demand and supply of healthcare facilities for which WHO recommended new strategy -Triage.

What is triage strategy?

- It is a time-tested, effective strategy to face the challenge of a sudden large load on the healthcare system which has limited availability of resources.
- In this approach, patients are categorised based on severity when there are a large number of people requiring an urgent care.
- The most severe are treated first as any delay will cost lives and the rest are treated later as per their level of severity.
- This idea was first introduced by Napoleon's military surgeons to treat battlefield injuries and it showed immediate impact.
- It is now standard practice in many countries when treating mass casualties and has also been used effectively during COVID-19.

What is the significance of this strategy?

- It has wide acceptance and implementation is based on the powerful but complex principles of justice and solidarity.
- It is where the interests of everyone are put above the interest of an individual where those who need care first are prioritised over those who can wait, irrespective of who they are.
- It works when there is social consensus on a level playing field.
- Serious triage doesn't only prioritise the sickest over the less sick but also discourages futile treatment for the very sick who are unlikely to benefit from the treatment.
- Thus, a 90-year-old who maybe otherwise bedridden could be refused admission or someone with an advanced untreatable cancer who develops COVID-19 may be put lower in priority.
- Thus executing triage in its truest sense is a big collective leap and needs a certain social sanction.

5.17 Taiwan's Covid Model

What is the issue?

- Due to its proximity to China, Taiwan was expected to be one of the countries most severely affected by the pandemic.
- But given its experience of fighting the 2003 SARS outbreak, Taiwan has dealt and is dealing well with COVID-19; here is an overview on that.

What was Taiwan's initial response?

- First of all, Taiwan did not ignore the alarms.
- It took seriously the evolving official and unofficial accounts, to form a picture of the emerging disease.
- Authorities used this information to launch enhanced monitoring in December 2019 itself.
- They have tirelessly implemented public health containment measures since Taiwan's first case was detected in January 2020.

What is the mechanism involved?

- After dealing with SARS, Taiwan established a nationwide infectious disease healthcare network.
- It provides the legal authority for transferring patients with highly contagious diseases to designated facilities.
- This has helped protect health systems and health professionals from being overwhelmed.
- It also allowed most non-Covid-19 health services to continue.

What were the other measures?

- By acting early and effectively, Taiwan also mitigated the economic impact of Covid-19.
- It implemented flexible adjustments for related quarantine measures for vessels and aircraft.
- This helped fisheries, offshore wind farms, and air transport industries continue operations.
- It ensured maintaining essential international, social, economic, and trade activities.
- Furthermore, public trust and cooperation with the government's response have been key to successfully containing Covid-19.
- In formulating disease control regulations, the government has adhered to the principles of reasonable response, minimum damage, and gradual adoption.
- It also maintained the balance between people's right to know and personal privacy and freedom.
- It upheld the principle of fairness as well as prioritised the protection of disadvantaged groups, including migrant workers.
- Throughout, Taiwan has emphasised the right to health and associated protections and strong opposition to human rights abuses.

Why is Taiwan's role in COVID handling significant?

- As of April 30, 2021, there had been 1,128 confirmed cases, including 12 deaths, in Taiwan.

- Life and work have continued much as normal for the majority of the population.
- Taiwan's response to Covid-19 has been one of the world's success stories.
- It plays an indispensable role in the global monitoring and early warning systems that detect the threat of emerging infectious disease.
- It has been able to comprehensively participate in and contribute to international Covid-19 supply chain systems, as well as global diagnostics, vaccine, and therapeutics platforms.
- It has madesignificant longstanding contributions to the international community in public health, disease prevention, and the human right to health.
- This would allow Taiwan to work with the rest of the world.
- These, thus, validate Taiwan's demand to be included in WHO and its meetings, mechanisms, and activities.

5.18 Bio Weapons

Why in news?

Recently there are reports emerging that China was discussing the weaponizing the coronaviruses in 2015.

What does the report say?

- In 2019, key official at the Wuhan Institute of Virology raised concerns about China's bio-research labs.
- China has restricted the access to data and destroyed relevant corona virus patient samples.
- It is also noted that there are certain inadequacies of China's in reporting to the Bioweapon Convention (BWC) Confidence-Building Measures.
- These measures are designed to monitor bio-weaponization by countries.

What are the other facts which support this argument?

- Earlier U.S. has raised concerns about the way in which the findings of the WHO's SARS CoV-2-origin probe were communicated.
- It said that China's substantial biological facilities has sparked dual-use concern that there is a possibility of biological matter with legitimate and acceptable-use is diverted to bio-weapon.
- Even the latest US Adherence to and Compliance with Arms Control, Non-proliferation, and Disarmament Agreements and Commitments report flags this concern.
- It mentions that available information on studies conducted at Chinese military medical institutions discusses identifying, testing and characterising diverse families of potent toxins with dual-use applications.
- Also, there are lingering questions over the safety of China's labs.
- When compared to high-level biosafety laboratories in foreign countries, 80% of the relevant specification/standard of biosafety laboratories in China belong to the specification and quality standards under the macro guidance.
- Only a small fraction are operational method standards, making it difficult to ensure the security of the biosafety laboratory due to lack of operational technical support.

What can be done now?

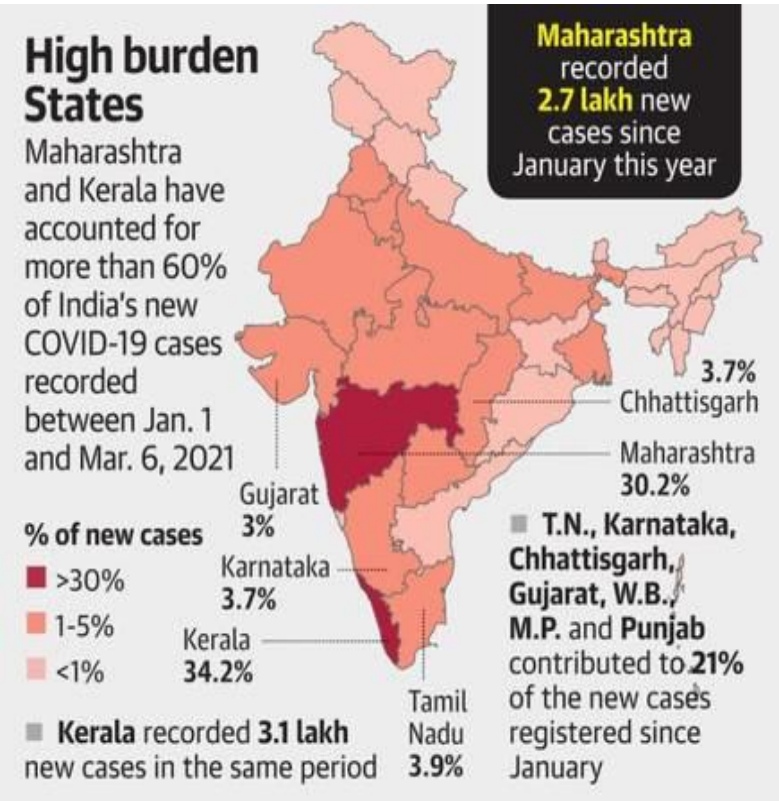
- China has acceded to United Nations Biological Weapon Convention in 1984.
- This underlines the need for both greater transparency regarding biological research/industrial use and stricter enforcement of bio-safety/anti-bioweaponisation compliance.
- National governments and multilateral forums must urge China and others which are in violation of BWC provisions, to become immediately compliant or face dire punitive measures.
- A trade action is an effective way to do this.

5.19 Understanding Why Kerala's Covid Caseload Remains High

What is the issue?

The has been growing concerns with Centre briefing that Kerala contributed to over 50% of the country's COVID cases

What are the centre's reasons for high caseload?



- **Intra-house transmission -** The rural-urban divide is very faint in Kerala leading to high intra-house transmission
- **Reinfections -** Kerala is witnessing high reinfections among the people who have received both doses of vaccine
- **Non-Communicable Diseases (NCD) -** High prevalence of NCD is yet another factor responsible for higher disease spread
- **High life expectancy -** As Kerala has high life expectancy, it has a higher proportion of those who are easily susceptible to the virus.
- **Migration -** Massive migration of people from within India and abroad is another cause for the virus spike
- **Containment zones -** Kerala has also not defined containment zones according to Centre's guidelines
- **Containment classification -** Kerala reviewed its containment classification as per 7 day moving average but it actually takes 14 days
- **Unlocking process** - Relaxations for tourism and the impending Onam festival has aggrevated the situation.

What is the other side of the view?

- **Measure of case fatality** is not an appropriate comparison across the population
- The fatality associated with Covid-19 intensified with pre-disposed risks of the patient as well as the age profile.
- **Comparability of Test Positivity Rates (TPR) levels** - Comparability not only depends on the magnitude of testing but also the testing protocols adopted by the health system.
- In Kerala, testing is done in clusters where the likelihood of positivity is obviously greater than the general population.
- **Extent of testing** - Greater access to testing and greater sensitivity to the spread of Covid-19 makes Kerala's numbers higher.
- However, Kerala's case fatality rate as of August 20 remains among the lowest (0.51) of all Indian states and against a national average CFR of 1.36.

How can a genuine comparative assessment be done?

- The entire road from the detection of infection to recovery has to be evaluated
- The evaluation should include the number of patients needing hospitalised care, the rate of their progression to oxygen dependence, ICU care and ventilators and finally, fatalities, etc.
- Comparative evaluation of this kind in many of the northern and eastern states needs adequate infrastructure.

5.20 The Purpose of a Vaccine

What is the issue?

- The whole world awaits a COVID-19 vaccine as the last resort to control the pandemic.
- In this context, it is important to examine the challenges vaccination poses to qualify as a 'public health intervention' in India.

What purposes does vaccination serve?

- Vaccinations have a dual purpose.
- **Individual level** - First is the ability to develop immunity by producing antibodies among those individuals who have taken a vaccine shot.
- In the midst of a pandemic, the popular perception for vaccination is that it safeguards oneself from the disease.
- It is this individualistic need that generates a huge demand for vaccines in the market.
- So, in the absence of government intervention, it will be affordable only for those who can pay for them.
- **Herd immunity** - The second and more crucial purpose of vaccination is to achieve herd immunity in a population.
- This is achieved by ensuring a threshold coverage.

What is threshold coverage?

- It is the proportion of population that needs to be covered for vaccination so that the entire population is protected.
- The threshold coverage for any disease in a given population is based on -
  i. the vaccine efficacy in a population
  ii. the rate of spread of infection through it, also known as infectivity rate
  iii. the natural immunity that already exists in the population due to prior exposure to the same disease or through cross infections
- The threshold coverage is estimated to be around 60% for COVID-19 vaccine to achieve population-level immunity.
- However, this should ideally vary, depending on different stages of the pandemic.

What are the considerations for vaccination?

- There can be individual as well as population-level considerations while introducing a vaccine amid a pandemic.
- **Individual level** - The concerns raised in the context of individual prevention include vaccine efficacy.
  - It refers to the probability that an individual, if vaccinated, can prevent the onset of infection.
- Equally important is the probability of adverse reactions that can arise among individuals.
- Both these parameters must be considered even to qualify vaccines as potential candidates for a public health intervention.
- **Population level** - There are several other complex economic, social, ethical and systemic factors that need to be looked into.
- Already, concerns are raised about the economic resources needed to make the vaccine available for a large population.
- In this context, some of the considerations include the following:
  - whether to charge or not for vaccination
  - the ability of an already weakened health system to take on the vaccination drive that is expected to cover the entire population
  - the cost of ensuring necessary support services including cold chains
  - human resources required for effective vaccine delivery
- Besides these, the most difficult ethical question posed is about who should be prioritised and the basis for such prioritisation.
- Equally relevant is the projected proportion of the population that may face adverse reactions and the ability of the health system to respond to those.
- Another aspect specific to the COVID-19 vaccine is the duration of protection provided.

What is the case with India?

- In the Indian context, it is not clear what outcome is expected of a population-based vaccination programme for COVID-19.
- The most dominant argument is that health workers need to be covered on a priority basis, and then the elderly.
- One of the arguments posed for targeting health workers is that it would protect the health system from collapsing due to COVID-19.
- If this is so, the health system cannot be confined to only health workers.
- A majority of stakeholders, even in terms of mere numbers, are always the patients and their caregivers.
- Second, and more crucial, is the goal of population-level immunity.
- The very purpose of it will be defeated if only a specific population group is targeted, when the pandemic can infect all groups similarly.
    - In New Zealand, preparations are on for a countrywide immunisation programme with a goal of covering the whole population with a threshold coverage.

5.21 Gearing up - India's Vaccination Programme

What is the issue?

- India has planned to roll out the vaccination programme for COVID-19 from 16 January 2021, with doctors, nurses and sanitation workers as part of the priority group to receive first.
- As India starts on vaccination, it is highly essential that the government bolsters public trust in the vaccination process.

What is the plan?

- India has approved two vaccines in emergency-use mode:
    1. Covishield by the Serum Institute of India, Pune
    2. Covaxin by Bharat Biotech Ltd.
- While it is still unclear who gets which vaccine, there are more doses of Covishield available at present than Covaxin, almost five to one.
- It could take a few months before the 30 million prioritised groups get one of their doses.
- Others, those in the 50-plus age group and those with comorbidities, will have to wait much longer.
- Notably, vaccines such as those by Pfizer and Moderna are also not made available for import by the private sector.

What are the concerns though?

- Covaxin belongs to a league of vaccines that has been approved without establishing its efficacy i.e. the extent to which vaccination protects from COVID-19.
- There have been differences among scientists such as on the best testing strategy, treatment, extent of infection.
- But the differences are more divisive for the approval of Covaxin.
- There is declining rate of infections and low relative mortality in India.
- So, India is not in as dire a state of emergency that requires it to approve an untested vaccine, when more clarity would likely have come by March 2021.
- Also, reports have emerged of trials in Bhopal where volunteers were seemingly under the impression that they were getting a protective shot when some were likely getting a placebo.
    - In medicine, a placebo is a substance, pill, or other treatment that appears to be a medical intervention, but is not.
    - Placebos are used when testing new drugs or sometimes when a patient has imagined his/her illness.
- Volunteers also complain of no medical follow-up when some developed symptoms such as fever, body pain and loss of appetite.

What is the need for caution?

- The vaccine may eventually prove protective. The adverse symptoms reported may also be seen as part of the variety of the human body's response.
- However, a vaccine that evokes distrust is self-defeating.
- With childhood immunisation, India has proven that it has the infrastructural backbone to inoculate millions.
- The dry runs to test the Co-WIN management software have reportedly given authorities valuable feedback on perfecting the prospective rollout.
- However, this could be undone if people do not turn up, and worse, if vaccine hesitancy rises.

What lies ahead?

- The pandemic gave India an opportunity to examine its dispensation of health care.
- Along with improving access, the government must seriously examine the conduct of vaccine trials.
- The government must work hard to bolster public trust in vaccination, and monitor the vaccination process for adverse reactions.
- On the other hand, Covaxin is best kept as a backup in the event of a sudden surge of cases till its efficacy data are available and acceptable.

5.22 Vaccine Hesitancy – COVID-19

What is the issue?

The poor uptake of the COVID-19 vaccine in India indicates the gaps in government's approach in building public trust in this regard.

How is the vaccine uptake rate?

- Tamil Nadu, perceived to be largely health literate, and relatively well-equipped with health infrastructure, achieved only over 16% of its targeted coverage on the launch day (16 January 2021).
- On the second day of vaccination, the compliance further dropped.
- In some States, vaccination was suspended.
- A marked favouring of the Covishield vaccine over Covaxin was also noticed in multiple States.
- The poor rate of uptake of the vaccine in most States only indicates that the government has not taken the people of the country along in this process.

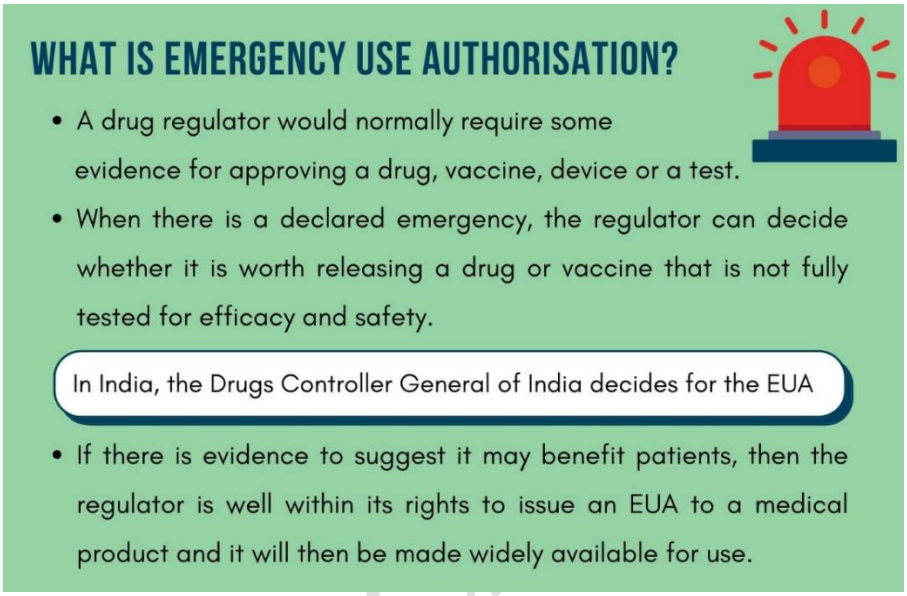
Was vaccine hesitancy addressed?

- A vaccine, unequivocally, is a public good.
- But the lack of transparency surrounding the roll-out of the COVID-19 vaccines has done little to enhance trust in this experiential principle.
- Studies measured high levels of vaccine hesitancy among the general population.
- It remains the same with health-care workers, the first in the line list of people to receive free vaccination.
- Clearly, vaccine hesitancy was not addressed sufficiently, or not taken seriously enough.
- The clearance for Emergency Use Authorisation (in Covaxin, it is emergency use authorisation in 'clinical trial mode') came.
- Following this, there was a high-handed announcement with little attempt to put out compelling evidence in the public domain.
- Nor were the multiple queries addressed in press conferences.
- The inability of the government, and the agencies involved, to amicably resolve controversies surrounding the clearance for Covaxin has had a direct consequence in vaccine uptake.

5.23 Emergency Use Authorisation - COVID Vaccines

Why in news?

- 'Emergency Use Authorisation' (EUA) has drawn attention around the world in line with vaccines that can help fight COVID-19.
- In India, too, the drug regulator has given Emergency Use Authorisation to three anti-Covid vaccines, the latest one being Russian Sputnik V.



Why is it important?

- In a pandemic situation, it is very important to restrain the spread of the pathogen in the quickest possible time.
- Typically, developing vaccines or drugs takes several years.
- A good part of this goes in carrying out trials to establish the vaccine's safety and efficacy.
- So the longer the wait, more people are likely to die.
- So, drug regulators in many countries follow a basic thumb rule.
    - This is to approve a drug or a vaccine if the known and potential benefits outweigh the known potential risks.

How does it work?

- An EUA does not mean that a vaccine has skipped essential safety trials.
- The regulators need to satisfy themselves that the product meets reasonable thresholds for safety and effectiveness before granting approval.
- In the US, for instance, the Food and Drug Administration grants EUA for Covid vaccines only after -
    i. a vaccine-maker has undertaken Phase 1 and Phase 2 trials
    ii. it is able to provide safety and efficacy data for Phase 3 trials as well, using data generated from over 3,000 participants
- In Phase 1 trials, a vaccine is given to a limited sample set of healthy people to assess its safety at higher doses.
- If Phase 1 does not throw up safety concerns, Phase 2 is undertaken on hundreds of people with different health conditions and from different population strata.
- This helps assess both the effectiveness and the side-effects.
- Phase 3 involves much larger sample, representative of the actual population, to assess both safety and efficacy.

How is it carried out in India?

- The process for using the EUA is less clearly spelt out in India.
- But the DGCI has also been issuing EUAs based on clinical trial data.
- In January 2021, the DCGI approved the first two vaccines:
    1. Covishield, produced by Pune-based Serum Institute of India under licensing agreement from AstraZeneca
    2. Covaxin, manufactured by Bharat Biotech
- The emergency approvals given to the three vaccines in India have helped in rolling out the largest vaccination drive in the world.
- But with the second wave proving quicker to spread than the first, capacity constraints are hitting the ramping up of vaccine supplies.

- Thus, granting EUA to new vaccines that have already been approved for emergency use in other countries becomes essential.

5.24 Revisiting the Vaccine Policy

Why in news?

Recently, Supreme Court in response to the affidavit filed by the centre said that centre should procure vaccine for all states instead of asking states to procure from market.

What does the affidavit say?

- It says that the Centre by its large vaccination programme has placed large purchase orders for vaccines as opposed to the State Governments and/or Private Hospitals.
- This has some effect on the prices negotiated i.e., it can buy vaccines cheaper than States or the private sector.
- The Centre will take 50% of this to give to States for the 45-plus age group, and the States get 25% of the total vaccine production for their use.
- Each State informs the centre about the number of vaccines it would receive and centre ensures that the prices of vaccine is uniform for all the States.
- The balance 25% in each State will go to the private sector based upon the contracts between private sector and vaccine manufacturers.

What will be the outcome of this?

- Now question arises that how is the private sector in a specific State defined, since contracts are at a corporate level and not by State units.
- Also there is a doubt about the absorption of 25% by the private sector since in all CoWIN sites the private sector share is under 3% and its allocation will be more in urban areas.
- Thus, instead of the full production at zero cost, the States now get one quarter of the production at twice or more the price paid by the Centre.
- The private sector will access the other quarter, at a landed cost that, based on current reports, might be up to 10 times the price it paid earlier.

Why centre must revisit its vaccine policy?

- First, India's vaccine policy is indefensible and not in line with international practice.
- Second it incoherent as it decontrols both price and quantity for every state.
- Third, it doesn't effectively address the essential problem in the reality.
- Centre is now threatening to penalise States which are not administering sufficient second doses.
- Moreover, it allows for just two vaccine manufacturers to produce vaccine in a heavily competitive drug manufacturing market.
- Currently the nation faces extreme shortage of vaccine which is exacerbated by adding 600 million 18 to 44-year-old citizens to 200 million unvaccinated people above the age of 45.
- In every other country, only the national government buys vaccines to vaccinate their citizens at free of cost except in Indonesia and Philippines.
- It is perplexing why Covaxin is not widely licensed, despite much of the core work in developing the vaccine was done at the ICMR-NIV in Pune.

What are the other problems?

- The affidavit says that centre has taken efforts to procure vaccines from other countries.
- But these negotiations are a complex undertaking as it is taking place through diplomatic channels.
- Centre also accepted the challenge of door-to-door vaccination but it wants to make vaccination easier to access, e.g. through pop-up centres in communities.
- Also there is no enough residual trust between the Centre and States for equitable distribution of vaccines.
- Hence such policy will increase the revenue of vaccine manufacturers and making vaccine supplies more expensive and less equitable across geographies.

5.25 India's Revised Vaccination Policy

Why in news?

Indian Prime Minster recently announced the shift to centralised procurement of Covid-19 vaccines.

How was it earlier?

- From January 16 to April 30, 2021, the Centre had procured and allocated vaccine doses to the states.
- This was available for free vaccination of three priority groups.
- These were healthcare workers, frontline workers, and persons above the age of 45.
- From May 2021, States were allowed to procure 25% of the vaccines manufactured and the Centre, 50%.
- [States had to procure 25% of the doses from the open market to vaccinate the 18-44 year age group.]

What is the new policy?

- **Procurement** - From June 21, 2021, the Centre will be directly procuring 75% of the doses manufactured.
- It will distribute this among the states.
- Vaccines will continue to be free for all those who choose to get their shot at government centres.
- **Private centres**- Private hospitals will have exclusive access to the remaining 25%.
- However, private centres can charge only Rs 150 as service charge over and above the vaccine price.
- The maximum vaccine price is Rs 780 for Covishield, Rs 1,410 for Covaxin and Rs 1,145 for Sputnik V.
- **Distribution** - The vaccines will be allocated to the states based on three positive metrics.
- These are population, disease burden and the progress of vaccination.
- One negative metric will be the wastage of vaccines.
- A state reporting good vaccination coverage will get a higher number of doses.
- On the other hand, a state recording a higher wastage will receive a lower number.

Why is the course correction now?

- The Supreme Court had termed the earlier vaccine policy "irrational and arbitrary".
- Several states had faced difficulties in procuring and managing the funding of vaccines.
- The Centre saw itself desperately short of supply right in the middle of India's deadly second wave.
- The hospital emergencies worsened the Centre's panic.
- So, it has taken up the responsibility of directly buying vaccines to States.
- The course correction in vaccine policy should help improve India's response to the pandemic.

5.26 Ramping Up Vaccine Supply

What is the issue?

- It is less than a month after the Centre revised its vaccination policy and took over the responsibility of vaccine procurement from the States.
- But, old worries of vaccine supply constraint appear to have resurfaced.

What is the current vaccination pace?

- The Centre's CoWIN database shows that the weekly pace of vaccination has declined to nearly 60% of what was seen in the week after June 21.
- This has caused several States, particularly in South India, to complain of a shortage.
- On June 21, 2021 the first day of the new policy, 91 lakh doses were administered.
- Until June 27, it was about 4 crore.
- The peak of June 21-27 saw 60 lakh vaccines a day becoming the norm.
- However, the last time India crossed that daily figure was July 3.

- So, the period July 5-11 saw only 2.3 crore vaccine doses dispensed.
- The daily doses have again slipped to 30-40 lakh.

What is the vaccination coverage so far?

- India still has managed to inoculate only 33% of its adult population with at least one dose.
- And just about 8% have been fully vaccinated (two doses).
- At this rate, it is impossible for the Centre to deliver on its stated goal of inoculating all Indian adults by the end of 2021.
- Also, there are clear signs of increasing number of cases.
- The nature of rise in cases and deaths in countries such as the U.S. and U.K suggests that India is not totally out of danger.

What does this call for?

- The concerns over a third wave have been voiced.
- But meaningful preparedness entails having enough vaccines.
- At least 86 lakh doses have to be administered every day.
- This target has to be met if all Indian adults are to be fully vaccinated by the end of 2021.
- Centre continues to put the onus on States for planning but does not address the concern of inadequate Covaxin supplies.
- It has ordered at least 8 crore doses since January 2021 but only 4.7 crore have been administered.
- While daily vaccination rates will see spikes and dips, aggressive publicity measures and campaigns are necessary to boost vaccination.
- The Centre and States must work together towards this.

5.27 Addressing the Vaccine Shortage

Why in news?

The massive vaccine shortage in the country has mooted the idea of compulsory licencing.

What is the current situation?

- The second wave of the COVID-19 pandemic has claimed large number of lives and the precious lives of the citizens are dependent on the vaccine manufactures.
- According to government data till April 26,2021, only 13.5 crore vaccine doses (9% of the Indian population) were administered and it is reported that the country is likely to face a vaccine shortage.
- Now the Supreme Court has highlighted the unconstitutionality of the new COVID vaccine policy- allowing vaccine manufacturers to fix prices which can lead to discrimination and vaccine inequity.
- It has directed the Centre to consider invoke compulsory licencing of drugs and vaccines under the Patents Act, 1970.

What is Compulsory Licencing?

- Compulsory Licensing (CL) allows governments to license third parties (other than the patent holders) to produce and market a patented product or process without the consent of patent owners.
- It is regulated under the **Indian Patent Act, 1970**.
- The application for compulsory license can be made any time after 3 years from date of sealing of a patent.
- The following conditions should be fulfilled by the applicant:
    - Reasonable requirements of public have not been satisfied;
    - Patented invention is not available to public at a reasonably affordable price;
    - Patented inventions are not carried out in India.
- According to **Section 92 of the Act**, CL can also be issued suo motu by the Controller of Patents.

- But this should be based on the notification issued by the centre if there is a case of either a national emergency or extreme urgency or for public non-commercial use.

What can the centre do now?

- The centre can address the present drug and vaccine shortage through its immense powers it has under the patents law.
- If it declares national emergency or extreme urgency, then willing company to manufacture the COVID vaccine can make an application to the Controller General of Patents.
- This secures a compulsory licence and the licence-holder can then go ahead and use the patented technology to manufacture the vaccine or the drugs.
- Large number of players in the market will lower the financial burden on the government and ensures dynamism in the COVID drugs and vaccines market.
- Also, this will ensure that the drug or vaccine gets cheaper and supplied adequately to meet the growing demand.
- However, there is a concern of potential litigation due to which other manufacturers are unwilling to seek compulsory licences.

How can this issue be addressed?

- Such concerns have to be alleviated by the Centre due to the gravity of the current situation.
- The patent holders can be adequately compensated by fixing a reasonable licence fee.
- The right to life of the people should be of prime importance over any commercial interests of the companies.
- Even the Russian and Hungarian governments have issued compulsory licences for remdesivir and made it available for cheaper prices to the public.

What can we infer from this?

- COVID-19 has disproportionately high impacts on the poorest and most marginalised and leaving patients to the fluctuations of the market where Big Pharma determines the prices is arbitrary.
- To reduce the numbers of cases and deaths, it is necessary that even the poorest of the poor have access to treatment (including access to oxygenated beds, ICU & ventilators) and free vaccines.
- Even the Supreme Court has said that Centre should procure all vaccines and negotiate the price with the vaccine manufacturers.
- Therefore, it is incumbent on the Central Government to ensure that the vaccines are available to all free of cost following the universal immunisation policy.
- This can be achieved by the compulsory licensing clause of Indian Patent law.

5.28 Indemnity Waiver for COVID-19 vaccines

What is the issue?

Despite DCGI granting Emergency Use Authorisation (EUA) for two vaccines, uncertainty in vaccine availability remains because of the government's indecision in granting indemnity.

What is a EUA?

- It is a mechanism to facilitate the availability and use of medical countermeasures (like vaccines), during public health emergencies.
- It allows the use of unapproved medical products in an emergency to diagnose, treat, or prevent serious or life-threatening diseases or conditions when certain statutory criteria have been met

What is the status of India's vaccine program?

- Drugs Controller General of India granted EUA to COVID-19 vaccines manufactured by Moderna and by Johnson & Johnson.
- In addition, India has an opportunity to receive about 10 crore doses of Pfizer-BioNTech's mRNA-based vaccine by the end of 2021.
- Yet, only 11% of the population has been fully vaccinated and 35.5% has received a single dose.

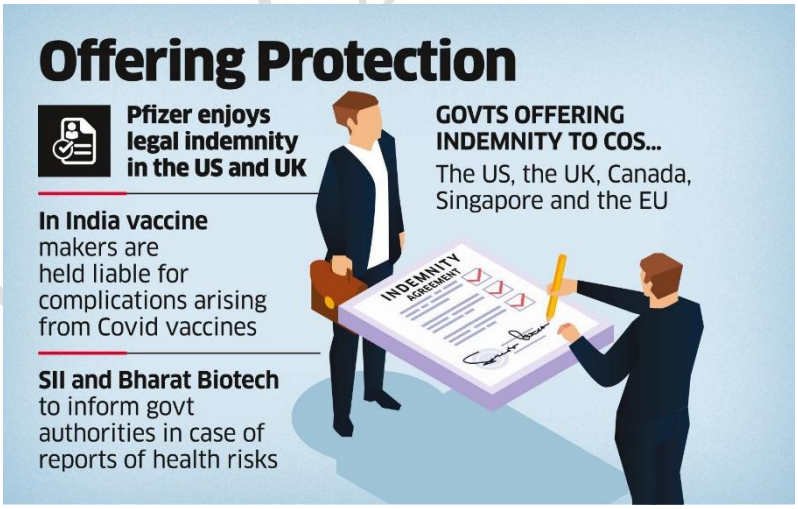
- Major reason for the underperformance is the **insufficient supply of vaccines**, which in turn is due to the demand from the manufacturers to grant indemnity.

What is indemnity?

- Vaccines are given EUA after a thorough review of their safety.
- However, there can be rare and serious Adverse Events Following Immunisation (AEFI) like vaccine-induced immune thrombotic thrombocytopenia and Myocarditis.
- Grant of indemnity by the government means that the manufactures **cannot be sued** in those countries by people who may experience AEFIs.
- However, it does not always mean beneficiaries cannot seek compensation for adverse events at all.
- But the bar to seek compensation is very high.

What is the International Practice?

- **U.S -** Pfizer and Moderna were granted immunity from liability.
- This protects them, until 2024, from lawsuits arising out of any foreseen and unintentional medical complications as a result of vaccination.
- WHO - In February, the WHO started a "No-Fault compensation program" for 92 low- and middle-income countries.
- This is the only global vaccine injury compensation mechanism and is funded by a small levy on each dose supported by the Gavi COVAX Advance Market Commitment.
- It is available for rare but serious adverse events associated with COVAX-distributed vaccines until June 2022.



What is the situation in India?

- The manufacturers of the three vaccines currently being administered in India (Covishield, Covaxin, and Sputnik V) have not been granted indemnity.
- Pfizer and Moderna have supplied their Covid-19 vaccines only to the countries that granted indemnities.

Why is the government hesitant on granting indemnity?

- **Accountability -** Indian regulations provide for compensation in case of injury or death of a trial subject.
- The idea is to hold the manufacturers accountable.
- **Additional Burden -** The legal responsibility for any vaccine-related injury in India lies with the manufacturers.
- Therefore, if manufacturers are granted indemnity, this would mean the Government has to provide compensation.
- **Misuse -** Indemnity might be misused as blanket protection for deliberate acts, fraud or instances of negligence.
- **Demand -** If some foreign manufacturers are granted indemnity, then manufacturers of the vaccines currently in use are likely to demand similar protections.

What are the existing safety mechanisms?

- Even if indemnity is granted, India has several safety mechanisms.

1. DCGI is empowered to take action against companies violating the Drugs and Cosmetics Act, 1940.
2. Any individual seeking compensation may directly file petitions before consumer courts and High Courts.
3. Recent amendments to the Consumer Protection Act, 1986 disallow individuals but permit the regulatory bodies to initiate class action suits based on complaints.

Class action suits - cases representing groups of people who have suffered from the same loss

What should the government do?

- Examine initiatives such as America's Countermeasures Injury Compensation Program in granting indemnity.
- Institutionalize legal safeguards from vaccine injuries supplemented by government funding.
- Utilize this opportunity to reduce vaccine 'licensing to availability gap' and to increase the vaccine availability

6. POLICIES

6.1 Draft Science, Technology and Innovation Policy

Why in news?

The government has recently released the draft 5th national Science, Technology and Innovation Policy (STIP).

Why is this significant?

- The policy outlines strategies for strengthening India's STI ecosystem to achieve the larger goal of Atmanirbhar Bharat.
- Previous STI policies were largely top-driven in formulation.
- The present STIP follows core principles of being decentralised, evidence-informed, bottom-up, experts-driven, and inclusive.
- It aims to be dynamic, with a robust policy governance mechanism that includes periodic review, evaluation, feedback, and adaptation.
- Most importantly, there is a timely exit strategy for policy instruments.

What are the objectives?

- The STIP will be guided by the vision of positioning India among the top three scientific superpowers in the decade to come.
- The aim is to -
    - attract, nurture, strengthen, and retain critical human capital through a people-centric STI ecosystem
    - double the number of full-time equivalent (FTE) researchers, gross domestic expenditure on R&D (GERD) and private-sector contribution to GERD every 5 years
    - build individual and institutional excellence in STI with the aim of reaching the highest levels of global recognition and awards in the coming decade

What is the Open Science Framework?

- STIP provides a forward-looking, all-encompassing Open Science Framework to provide free access for all to findings from publicly funded research.
- Private-sector researchers, students, and institutions will have the same accessibility.
- Output from research that is not funded by the government will be outside the purview of this framework. However, they will be encouraged to participate.
- This framework will be largely community-driven, and supported with necessary institutional mechanisms and operational modalities.
- Open Science fosters more equitable participation in science through increased access to research output. It ensures -
    i. greater transparency and accountability in research
    ii. inclusiveness
    iii. better resource utilisation through minimal restrictions on reuse of research output and infrastructure
    iv. a constant exchange of knowledge between the producers and users of knowledge

What is the rationale for One Nation, One Subscription?

- The policy proposes buying bulk subscriptions for all journals.

- It thereby envisions free access to all journals, Indian and foreign, for every Indian against a centrally-negotiated payment mechanism.
- Scientists are producers of scientific knowledge in the form of scholarly articles.
- But the consumers of this knowledge such as line departments, innovators, industry, the society at large, etc. are several times larger in number.
- In the present mechanisms, they do not have access to this knowledge.
- R&D institutions in India spend huge amounts of money subscribing to journals, especially the international high impact-factor ones.
- As per a rough estimate, this amount comes to nearly Rs 1,500 crore per annum.
- But still, only a third of the country's total 3.5 lakh-odd researchers get access to these journals.
- Under STIP's payment mechanism, the amount may be higher than what institutions together pay today, but will facilitate access to India's over 1.3 billion people.
- The larger idea behind One Nation, One Subscription is thus to democratise science.

How about participation of women in Science?

- Over the last 6 years, women's participation in S&T has doubled in India; however, overall participation of women in R&D continues to be only about 16%.
- There has been considerable improvement in the participation of women in science education both at the Bachelor's and Master's levels (53% and 55% respectively as per AISHE 2019).
- However, there is a persistent gap at the doctoral level between male (56%) and female graduates (44%).
- In this context, policy interventions in Science will bring transformative change.
- In this regard, the STIP has made recommendations such as -
    i. mandatory positions for excluded groups in academics
    ii. 30% representation of women in selection/evaluation committees and decision-making groups
    iii. addressing issues related to career breaks for women by considering academic age rather than biological/physical age
    iv. a dual recruitment policy for couples
    v. institutionalisation of equity and inclusion by establishing an Office of Equity and Inclusion, etc

What does the policy say about funding in R&D?

- India's gross domestic expenditure on R&D (GERD) stands at 0.6% of GDP.
- This is quite low compared to other major economies that have a GERD-to-GDP ratio of 1.5% to 3%.
- This can be attributed to inadequate private sector investment (less than 40%) in R&D activities in India.
- In technologically advanced countries, the private sector contributes close to 70% of GERD.
- STIP has made some major recommendations in this regard, such as -
    i. expansion of the STI funding landscape at the central and state levels
    ii. enhanced incentivisation mechanisms for leveraging the private sector's R&D participation
- The policy also offers creative avenues for collaborative STI funding through a portfolio-based funding mechanism.
- It is called the Advanced Missions in Innovative Research Ecosystem (ADMIRE) programme.
- It supports distributed and localised collaborative mission-oriented projects through a long-term investment strategy.
- A national STI Financing Authority, along with an STI Development Bank, needs to be set up to direct long-term investments in select strategic areas.
- The STIP also suggests modification or waiver of General Financial Rules (GFR), for large-scale mission mode programmes and projects of national importance.

6.2 Opening Up the Geo-Spatial Sector

Why in news?

- The Ministry of Science and Technology has released new guidelines for the Geo-spatial sector in India.
- The guidelines deregulate the existing protocol and liberalise the sector to a more competitive field.

GEO-SPATIAL DATA

- Geospatial data is data about objects, events, or phenomena that have a location on the surface of the earth.
- The location may be static in the short-term, like the location of a road, an earthquake event, malnutrition among children, etc.
- It could also be dynamic like a moving vehicle or pedestrian, the spread of an infectious disease and the like.
- Geospatial data combines -

1. location information
2. attribute information (the characteristics of the object, or phenomena concerned),
3. temporal information or the time at which the location and attributes exist

- The past decade has seen an increase in the use of geo-spatial data in daily life with various apps such as for food delivery, e-commerce and even weather apps.

What is the present policy on geo-spatial data?

- There are strict restrictions on the collection, storage, use, sale, and dissemination of geo-spatial data and mapping under the current regime.
- The policy had not been renewed in decades and has been driven by internal as well as external security concerns.
- The sector so far is dominated by the Indian government as well as government-run agencies such as the Survey of India.
- Private companies need to navigate a system of permissions to be able to collect, create or disseminate geo-spatial data.
- These include permissions from different government departments (depending on the kind of data to be created) as well as the defence and Home Ministries.

What was the need for tight regulations?

- Geo-spatial data was initially conceptualised as a matter solely concerned with security.
- So, geo-spatial data collection was the prerogative of the defence forces and the government.
- The Kargil war highlighted the dependence on foreign data and the need for indigenous sources of data.
- With this, GIS mapping was also rudimentary, and the government invested heavily in it after the war.

Why is the deregulation now?

- The system of acquiring licenses or permission, and the red tape involved, can take months.
- This delayed the projects, especially those that are in mission mode, for both Indian companies as well as government agencies.
- The deregulation would eliminate the requirement of permissions as well as scrutiny, even for security concerns.

- Indian companies can now self-attest, conforming to government guidelines without actually having to be monitored by a government agency.
- More and more sectors such as agriculture, environment protection, power, water, transportation, communication, health (tracking of diseases, patients, hospitals etc) rely heavily on geo-spatial data.
- But there is a huge lack of data in the country.
    - This impedes planning for infrastructure, development, natural calamities as well as businesses which are data-based.
- Given this, the mapping of the entire country, that too with high accuracy, by the Indian government alone could take decades.
- There is thus a need to incentivise the geo-spatial sector for Indian companies and increased investment from private players in the sector.
- There has also been a global push for open access to geo-spatial sector as it affects the lives of ordinary citizens.
- The new guidelines have thus ensured such an open access, with the exception of sensitive defence or security-related data.
- Large amounts of geo-spatial data are also available on global platforms.
    - This makes the regulation of data that is freely available in other countries, untenable.

6.3 National Policy for Rare Diseases 2021

Why in news?

The Union Health and Family Welfare ministry recently approved the National Policy for Rare Diseases 2021.

What are rare diseases?

> **WHO defines rare disease as often debilitating lifelong disease or disorder with a prevalence of 1 or less, per thousand population**

- Rare diseases are broadly defined as diseases that infrequently occur in a population; three markers are used:
    1. the total number of people with the disease
    2. its prevalence
    3. the availability/non-availability of treatment options
- However, different countries have their own definitions.
- It is defined in a way to suit their specific requirements and in context of their own population, health care system and resources.
- As per an estimate, there are 7,000 known rare diseases with an estimated 300 million patients in the world.
    - Of this, 70 million are in India.
- They include inherited cancers, autoimmune disorders, congenital malformations, Hirschsprung's disease, Gaucher disease, cystic fibrosis, muscular dystrophies and Lysosomal Storage Disorders (LSDs).

What are the key provisions in the policy?

- **Objective** - The policy intends at lowering the cost of treatment of rare diseases (diseases listed under Group 1 in the rare disease policy).
- It also aims at increasing the focus on indigenous research and local production of medicines.
- **Support** - Those who are suffering from rare diseases that require one-time treatment will have the financial support of up to Rs 20 lakh under the umbrella scheme of Rashtriya Arogya Nidhi.
- Financial assistance will not be limited to just the BPL families.
- Around 40% of the population covered under the Pradhan Mantri Jan Arogya Yojana will benefit from the policy.
- **Funding** - The policy will make use of a crowdfunding mechanism to cover the cost of treatment of rare diseases.
- As part of it, corporates and individuals will be encouraged to extend financial support through a robust IT platform.

- **Registry** - A national hospital-based registry of rare diseases will be created.
- This is to ensure that adequate data and comprehensive definitions of such diseases are available for those interested in research and development.
- **Detection** - The policy aims to screen and detect rare diseases at early stages, which will in turn help in their prevention.
- It aims to achieve this through the help of Health and Wellness Centres, District Early Intervention Centres and counselling.

What is the significance?

- Rare diseases are difficult to research upon.
- Also, availability and accessibility to medicines are important in the process of treatment.
- Fund support from government is vital for continual treatment of those with rare diseases.
- The Supreme Court and various high courts had expressed concern about the lack of a national policy for rare diseases.
- The policy thus aims to help the nation overcome these fundamental challenges.

6.4 Health Data Management Policy

What is the issue?

The CoWin portal for COVID-19 vaccines has come under criticism due to the absence of a privacy policy.

What is the Health Data Management Policy?

- CoWin follows the privacy policy of the National Digital Health Mission (NDHM) - the Health Data Management Policy.
- Other digital health initiatives, such as telemedicine, hospital management systems and insurance claims management, are also tied to this Policy.
- The Policy seeks to develop a national health information system.
- It facilitates the creation of Unique Health Identification (UHID) for individuals and healthcare providers.
- It also facilitates the collection, storage, processing and sharing of personal health information, as electronic health records (EHRs).
- Every individual's UHID is linked to his or her EHR.

What are the shortcomings?

- **Privacy** - Despite the benefits, digitisation entails significant risks to privacy, confidentiality and security of personal health data.
- The Policy aims to mitigate these risks, through two guiding principles:
    1. "security and privacy by design"
    2. individual autonomy over personal health data
- But fundamental 'design flaws' may end up increasing instances of personal health data breaches.
- **Legal backup** - The Supreme Court, in Puttaswamy case, held that the right to informational privacy is a fundamental right.
- Any encroachment on this must be supported by law.
- It also calls for enacting a comprehensive data protection legislation.
- Contrary to this, the digitisation process being rolled out under the NDHM Policy is not supported by any law.
- **Regulation** - Setting up a regulatory authority entails a law that defines the boundaries within which it can function.
- It should also ensure independence from government interference and accountability to Parliament.
- But the Policy itself establishes the NDHM to function like a regulator.

- It authorises the NDHM to performlegislative, executive and quasi-judicial functions and define its own governance structure.

What are the risks involved?

- There is a possibility of secondary use of digital health data for research and policy planning by private firms.
- Anonymised datasets can be easily de-anonymised to link back to personally identifiable information, risking individual privacy.
- The policy also does not stipulate 'data masking' available to individuals to ensure confidentiality.
- [Data masking - technique to hide specific sensitive health information in EHRs accessible even to health care providers only with the specific consent of the individual.]
- The Policy also does not limit the use of aggregate health data to public health purposes.
- Without strict purpose limitation, private firms may use people's health data to enhance profits.
- The Policy also does not require reporting of personal data breaches to affected individuals.
- The guiding principle of individual autonomy is invoked through 'informed consent' for collecting and processing personal health data.
- The Policy mandates informed consent only prior to the collection of data.
- It applies in case of any change in the privacy policy or in relation to any new or unidentified purpose.
- This suggests that one-time consent for one or more broad purposes may be sufficient.
- But with this, individuals may ultimately end up with little or no control over their data.