

Science & Technology

The background is a complex digital collage. On the left, a satellite with four solar panel arms is shown against a starry space background. In the center, a glowing blue globe of Earth is overlaid with a white network grid of nodes and connecting lines. The right side of the image is filled with various data visualization elements, including bar charts, pie charts, and line graphs, all in shades of blue and white. A network diagram with nodes labeled 'SHARED NODE' and 'ACCESS POINT' is visible on the right. The overall aesthetic is high-tech and futuristic.

50 most important topics Part IV

LAST BATCH

RAPID REVISION

CSAT ₹1,500 GS ₹3,500

CSAT + General Studies ₹4,000

MOST IMPORTANT TOPICS FOR PRELIMS 2024



HOURS

1500 TOPICS

10th May 2024 - 29th May 2024

- 6 FLTs (3 GS+ 3 CSAT)
- Value Additions Material
- Subject Specific MCQS



Thrombosis with Thrombocytopenia Syndrome (TTS)

Context-British pharmaceutical giant AstraZeneca has made the admission in court documents that its Covid-19 vaccine can cause a rare side effect known as Thrombosis with Thrombocytopenia Syndrome (TTS).

- Court documents state that this condition may, in rare cases, result from the Covishield vaccine, which was developed by AstraZeneca and Oxford University and is produced by the Serum Institute of India. Covishield was extensively administered to Indians during the waves of Covid-19.

Thrombosis with Thrombocytopenia Syndrome (TTS)

Thrombosis Thrombocytopenia Syndrome (TTS)

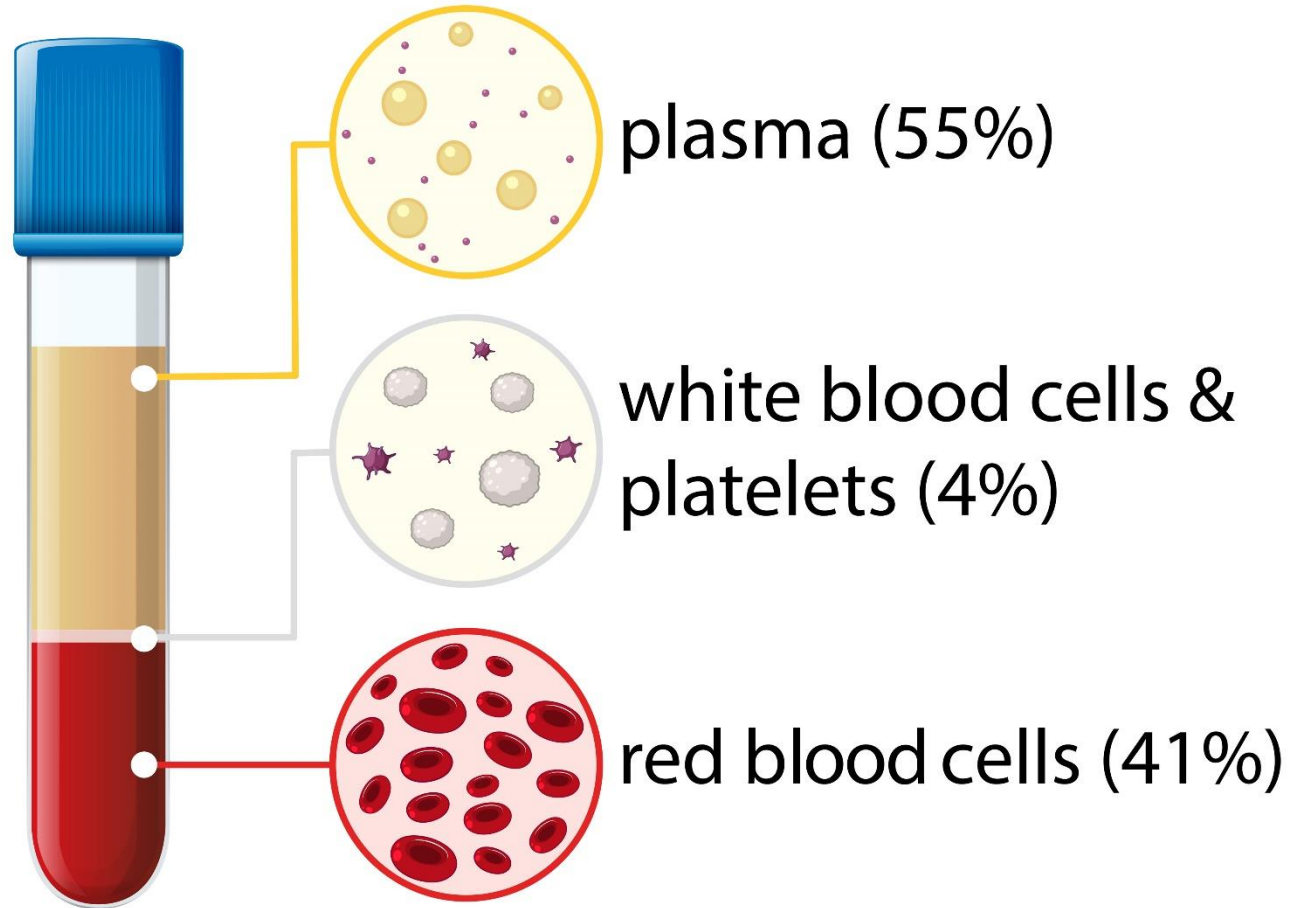
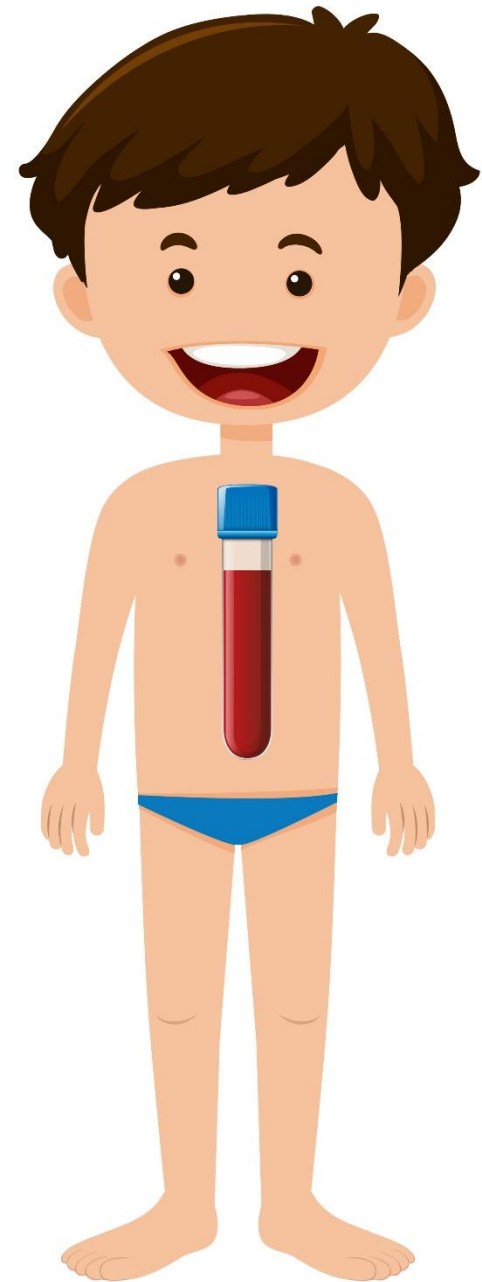
- It refers to **the clot in blood vessels**, and it occurs in very rare cases, following the use of certain types of vaccine.
- TTS is thrombosis with thrombocytopenia syndrome, which is basically **clot in blood vessels of the brain or elsewhere**, along with a **low platelet count**.
- It is known to occur in very rare instances following certain types of vaccines and also from other causes.
- According to the WHO, adenovirus vector vaccines in particular have been rarely associated with this condition.
- The World Health Organization has flagged the condition as **rare but serious and life-threatening**.

Thrombosis with Thrombocytopenia Syndrome (TTS)

Symptom

- In addition to easy bruising or small blood spots under the skin beyond the injection site, symptoms may include severe or ongoing headaches, blurred vision, shortness of breath, chest pain, leg swelling, and persistent abdominal pain.

Composition of Blood

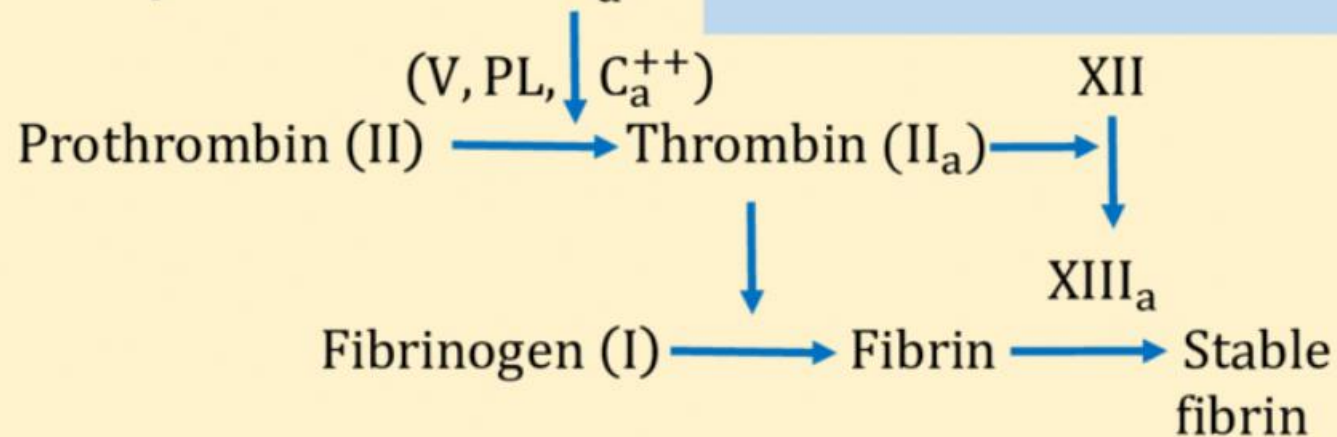


- VII - Stable factor, serine protease
- IX - Christmas factor, serine protease
- XI - Plasma thromboplastin, antecedent serine protease
- XII - Hageman factor, a serine protease
- XIII - Fibrin stabilizing factor, transglutaminase
- PL - Platelet membrane phospholipid
- C_a^{++} - Calcium ions
- TF - Tissue factor

Extrinsic pathway

Tissue damage → TF: VII_a

Common pathway



Intrinsic pathway

Surface contact

XII_a ← XII

XI_a ← XI

IX_a ← IX

(PL, VIII, Ca⁺⁺)

X → X_a

(V, PL, Ca⁺⁺)

XII

XIII_a

Fibrinogen (I)

Fibrin

Stable fibrin

Tiantong Project

Context- A team of Chinese engineers and scientists have developed the world's **first satellite that lets smartphones place a call directly** through it, instead of mobile towers.

- The idea is, that in case of an **emergency where mobile connectivity may be severely impacted** because of a natural calamity or any other disaster, people can call for help directly, by connecting to an overhead communication orbiter.

Tiantong Project

- The idea for such a satellite came about after 2008, when Sichuan, a province in southwestern China, was struck by a devastating **magnitude-8 earthquake, resulting in the tragic loss of over 80,000 lives.**

Tiantong Project

- What made the situation far worse back then was the **communication breakdowns** in affected areas, which in turn severely hindered rescue operations, thus compounding the crisis.
- In response to this disaster, the Chinese government started the **Tiantong Project** (Named after the Chinese term for “connecting with heaven,”), a satellite communication system.
- The purpose of the satellite is to provide **universal access to communication** services irrespective of socio-economic status.
- Sixteen years since its inception, the Tiantong Project has witnessed some major advancements in satellite communication technology. This, as if by miracle coincides with new trends and developments in mobile phone connectivity.

Tiantong Project

- The deployment of the Tiantong-1 series involves launching **three satellites orbiting synchronously at an altitude of 36,000 kilometers**. This has the potential to revolutionise communication across the Asia-Pacific region, from the Middle East to the Pacific Ocean.

Mobile phones compatibility

- In September of the previous year, Huawei Technologies introduced the world's first smartphone capable of satellite calls. These smartphones **were compatible with the Tiantong satellites**. Globally, the **first smartphone to advertise satellite calling as a feature was the iPhone 14**.
- Huawei's breakthrough innovation paved the way for **other Chinese smartphone manufacturers, including Xiaomi, Honor, and Oppo**, to follow suit, catering to a growing demand for satellite-enabled mobile devices among Chinese consumers.

Tiantong Project

Challenges

- However, the realization of direct satellite connectivity for mobile phones posed formidable technical challenges, particularly concerning **passive intermodulation (PIM) interference**. PIM has plagued commercial communication satellite networks, hindering further technological advancements.
- In response, Chinese scientists spearheaded groundbreaking research to mitigate PIM effects, culminating in the development of innovative **suppression techniques and advanced detection technology**.

Tiantong Project

Tiantong Project and SpaceX's Starlink

- In contrast, **SpaceX's Starlink satellite constellation**, while offering similar capabilities, operates in **low-Earth orbit** and primarily targets older 4G phones, highlighting divergent approaches to satellite communication technology.
- As the global space race continues to evolve, the competition between China's Tiantong Project and SpaceX's Starlink promises to shape the future of satellite communication, with profound implications for connectivity worldwide.

PRATUSH Telescope

Context- Astronomers are looking forward to opening a new window on the universe by posting **high-resolution telescopes on the moon, and in orbit** around it.

- There are numerous proposals to do this from astronomers around the world — including one from India called PRATUSH.

Need to place telescope on moon

- On the earth, optical telescopes (which collect visible light at longer wavelengths) and radio telescopes (which collect radio waves with the shortest wavelengths) have to peer through **layers of the planet's atmosphere**.
- While it is becoming increasingly difficult for optical instruments to see through the **polluted skies**, radio telescopes also **contend with radio and TV signals** adding to the cacophony of the electromagnetic 'hiss' from the communications channels used by radar systems, aircraft, and satellites.
- It also does not help that the earth's ionosphere **blocks radio waves coming from outer space**



PRATUSH Telescope

- Scientists tried to find a way out of this by launching radio telescopes into **orbit around the earth**. But this only made the problem worse, as orbiting telescopes started **receiving radio noise from the whole planet** along with signals from outer space. So astronomers are now seriously considering an idea they have toyed with since the 1950s: placing optical and radio telescopes on the far side of the moon, which always faces away from the earth.

Benefits on moon

- The pristine, airless desolation of the moon provides optical telescopes crystal-clear **seeing conditions throughout the long lunar night**, which lasts two weeks at a time.
- Radio telescopes on the lunar far side will also be protected by a 3,475-km-thick wall — a.k.a. the moon (its diameter is 3,476 km) — that blots out radio transmissions from the earth and electrically charged plasma winds blowing from the Sun.

PRATUSH Telescope

- In the past, the enormous costs involved discouraged scientists from setting up lunar telescopes. But renewed interest among spacefaring nations to return to the moon promises to open up “the most radio-quiet location in the solar system”, to quote The Royal Society, to astronomers.
- Terrestrial instruments can’t detect this minute frequency drop. Instead, moon-based instruments are our best bet to spot this signal from the **Dark Ages**, which would be essentially free from the influence of any starlight (since there were no stars then).

PRATUSH Telescope

The oldest light in the universe

- Once upon a time, cosmologists believe, everything in the cosmos was condensed into an infinitesimally small, incredibly dense blob in the void that exploded with a '**Big Bang**'.
- The resulting fireball cooled as it spread and its blinding light faded into a gathering darkness.
- At some point, the young universe resembled a formless sea of murky matter, highlighted only by **traces of primordial hydrogen and helium**.
- This **darkness persisted from some 300,000 to half a billion years** after the Big Bang, which is why there is so little direct evidence today of this important period in the cosmic story.
- The blackness in the heavens was banished only when the **first stars switched on their nuclear power-plants** and the cosmos continued to expand. We see this expansion now as a **faint glow called the cosmic microwave background (CMB)** – the oldest light in the universe – which can be captured by radio telescopes.



PRATUSH Telescope

- Meanwhile, the universe went 'quiet' for tens of millions of years afterwards as gravity began to build the first stars and galaxies. **This period of time between the initial scattering of the CMB radiation and the birth of the first stars is known as the Dark Ages.**
- It is believed the **neutral hydrogen pervading the cosmos during the Dark Ages absorbed some of the CMB radiation** to produce an extremely small dip in the frequency of the spreading radio waves.
- We want to study the Dark Ages period because it connects how the early universe evolved into the universe we see today

PRATUSH Telescope

PRATUSH radio telescope

- Although the technologies for these instruments exist, it is difficult for scientists to deploy them on the moon.
- An **alternative approach would be to orbit the moon** instead of landing on the surface and study the data when the satellite is behind the moon.
- This is what Indian scientists plan to do with the **radio telescope PRATUSH (Probing ReionizATIion of the Universe using Signal from Hydrogen), to be sited on the moon's far side.**
- PRATUSH is being built by the **Raman Research Institute (RRI) in Bengaluru** with active collaboration from the **Indian Space Research Organisation (ISRO).**

PRATUSH Telescope

- Initially, ISRO will place PRATUSH into orbit around the earth.
- After some fine-tuning, the space agency will launch it moonwards.
- **Although earth orbit** will have significant radio frequency interference (RFI), it will have advantages compared to ground-based experiments, such as operating in **free space and lesser ionosphere impact** .
- PRATUSH in lunar orbit will have the ideal observing conditions operating in free space with minimal RFI and no ionosphere to speak of.
- It will carry a wideband frequency-independent antenna, a self-calibrating analog receiver and a digital correlator to **catch radio noise in the all-important signal from the Dark Ages**.
- As astronomers open new windows from the moon to look at the far reaches of the universe, who knows what discoveries await them.
- One thing is certain: they are in for some exciting times as the cosmos yields clues to some of its greatest mysteries, such as dark energy (which pushes the universe in every direction at an accelerating rate), primordial black holes and, indeed, the very nature of the cosmos.

PRATUSH Telescope

Other projects

LuSEE-Night

- The Lunar Surface Electromagnetic Experiment-Night mission, or LuSEE-Night for short, is a small **radio telescope** being funded by **NASA and the U.S. Department of Energy**
- It will blast off for **the far side of the moon** in 2025 to hunt for the cosmic Dark Ages

Argonaut

- ESA is getting ready to launch a radio telescope to the **moon's far side** on board its lunar lander, 'Argonaut', by 2030

PRATUSH Telescope

Moon-orbiting radio telescope

- China's **moon-orbiting radio telescope** scheduled for launch in 2026.
- Another of its satellites, Queqiao-2, intended as a communications relay between the earth and future missions, probably entered into orbit around the moon on March 24. Its payload includes a 4.2-m antenna that will be used as, among other things, a radio telescope.

Hepatitis B is a public health concern in India

Context-According to a new study conducted by Sir Ganga Ram Hospital, New Delhi, **Hepatitis B is a public health concern in India**; but very few know about its transmission, effects & vaccination.

- Over 3,500 participants, excluding healthcare workers and individuals below 18 years, were surveyed

Key Highlights

- **Just 25 per cent of respondents had adequate knowledge about the disease**, including its transmission methods, effects on the liver and the critical importance of vaccination.
- Only 22.7 per cent of participants had **completed the full Hepatitis B vaccination course**.

Immunogenicity refers to the ability of therapeutic protein products to stimulate an immune response

Hepatitis B is a public health concern in India

- HBV infection affects around 296 million people globally. It causes approximately 887,000 deaths yearly due to complications like end-stage liver cirrhosis and liver cancer.
- **Infection rates remain high, especially in countries with lower socio-demographic indices such as India.** This is despite the fact that an effective vaccine against the disease has been available for over 30 years.
- The hospital stated that **Hepatitis B surface antigen (HBsAg) positivity prevalence is between two per cent and eight per cent.**
- HBsAg is a protein on the surface of HBV. It can be detected in high levels in serum during acute or chronic HBV infection.
- A recent meta-analysis has even suggested an overall prevalence of 3.70 per cent. This translated to about 37 million HBV carriers in India, according to the hospital.

Immunogenicity refers to the ability of therapeutic protein products to stimulate an immune response

Hepatitis B is a public health concern in India

Way forward

- **Educational campaigns** should focus on the general public, with particular emphasis on women, older individuals, those with lower education levels and rural residents, who demonstrated lower knowledge scores and vaccination rates in the study participants, according to Arora.
- People should also be **made aware** about the importance of completing the full vaccination schedule for adequate efficacy. This was because it was not uncommon for people to have one or two doses of vaccination and forget the last one, Arora noted.
- Dr Ashish Kumar, a co-author of the study, observed that comprehensive strategies addressing both health literacy and vaccination coverage were vital for achieving the national and global targets for HBV control.

Immunogenicity refers to the ability of therapeutic protein products to stimulate an immune response

Hepatitis B is a public he

Hepatitis

- It is an inflammation of the liver. The condition can be self-limiting or can progress to fibrosis (scarring), cirrhosis or liver cancer.
- There are 5 main hepatitis viruses, referred to as types A, B, C, D and E.
- These 5 types are of greatest concern because of the burden of illness and death they cause and the potential for outbreaks and epidemic spread.
- In particular, types B and C lead to chronic disease in hundreds of millions of people and, together, are the most common cause of liver cirrhosis and cancer.

Types of Hepatitis

	TRANSMISSION	PREVENTION	TREATMENT
Hepatitis A	Eating contaminated food or drinking contaminated water	<ul style="list-style-type: none">• Practicing good hygiene• Vaccine	No treatment
Hepatitis B	Through contact with the blood or bodily fluids of an infected person	<ul style="list-style-type: none">• Practicing good hygiene• Vaccine• Blood screening	<ul style="list-style-type: none">• Alpha interferon• Peginterferon
Hepatitis C	Blood-to-blood contact	<ul style="list-style-type: none">• Practicing good hygiene• Avoid sharing needles, toothbrushes, razors or nail scissors	Direct-acting antiviral drugs
Hepatitis D	Contact with infected blood (only occurs in people already infected with hepatitis B)	<ul style="list-style-type: none">• Hepatitis B vaccine• Avoid sharing needles, toothbrushes, razors or nail scissors	Interferon
Hepatitis E	Eating contaminated food or drinking contaminated water	<ul style="list-style-type: none">• Practicing good hygiene• Avoid drinking water that has come from a potentially unsafe source	No treatment

**Which one of the following statements is not correct?
(UPSC 2019)**

- (a) Hepatitis B virus is transmitted much like HIV.
- (b) Hepatitis B unlike Hepatitis C, does not have a vaccine.
- (c) Globally, the number of people infected with Hepatitis B and C viruses are several times more than those infected with HIV.
- (d) Some of those infected with Hepatitis B and C viruses do not show the symptoms for many years

India TB Report 2024

Context-Recently **India TB Report 2024** recently released by the **Union Health Ministry**.

Key Highlights

TB and risk factors

- The report flags risk factors like **undernourishment, HIV, diabetes, alcohol use and smoking** that affect both the infection rate and treatment outcomes.

Undernourishment:

- **Nearly 7.44 lakh TB patients were undernourished in 2022.** To improve nutrition, the government provides a **monthly support of Rs 500** and has **disbursed nearly Rs 2,781 crore** to nearly one crore beneficiaries. Other than that, the **Ni-kshay Mitra programme** calls for donation of food baskets.

India TB Report 2024

HIV:

- **People living with HIV have a 20-times higher risk of developing symptoms of TB** as compared to the normal population. Altogether 94,000 TB patients in 2022 had HIV. The programme provides preventive therapy to the HIV positive, ensures early diagnosis of HIV and TB through either programme.

Diabetes:

- Of the 3.70 lakh TB patients with diabetes globally in 2022, 1.02 lakh were in India as per estimates. **Diabetes escalates the likelihood of contracting TB two-to-three fold**, which in turn is linked to increased risk of multi-drug resistant TB. The TB treatment also does not work as well in diabetics. Nearly 92 per cent of the TB patients were screened for diabetes in 2023, with 7.7 per cent being diagnosed with it. And, nearly 63 per cent of those diagnosed initiating diabetes treatment as per the report.

India TB Report 2024

Alcohol:

- A daily intake of more than 50 ml of alcohol increases the risk of TB infection, active infection and recurrence of infection. Around 18.8 lakh or 74 per cent of TB patients underwent alcohol use screening, out of which 7.1 per cent were identified as alcohol users.

Tobacco:

- In 2023, around 19.1 lakh or 75 per cent of TB patients were screened for tobacco use, of whom 11 per cent were identified as tobacco users. And 32 per cent of these people were linked to the tobacco cessation services as per the report.

TB CASES IN INDIA OVER THE YEARS

	India TB Report 2020	2023	2024
Estimated TB cases	26.9 lakh	27.4 lakh	27.8 lakh
Number of cases reported	24.04 lakh	24.2 lakh	25.5 lakh
Reporting from private sector	6.8 lakh	7.3 lakh	8.4 lakh
% cases from private sector	28.20%	30%	32.90%
Estimated mortality	4.36 lakh	3.2 lakh	3.2 lakh

India TB Report 2024

Analysis

- While the number of cases and deaths due to tuberculosis has been on the decline since the baseline year of 2015, **it hasn't kept pace with the target that India has set.** There were an estimated 27.8 lakh TB cases in 2023, a marginal decline from the estimated 28 lakh in 2015.
- The positive development has been the improvement in the actual number of cases diagnosed. With a record high of 25.5 lakh cases testing positive in 2023, the gap between the estimates and actual numbers is closing. This is an important marker as the “missing cases” are assumed to have not received treatment, continuing to spread the infection to others. There were **only 2.3 lakh missing cases in 2023, as compared to 3.2 lakh the year before.**

India TB Report 2024

- There has also been an **increase in reporting of cases from the private sector**. Nearly 33 per cent or 8.4 lakh of the 25.5 lakh cases reported in 2023 came from the private sector.
- To compare, only 1.9 lakh cases were reported by the private sector in 2015. In fact, the data shows that treatment success rate was slightly higher in the private sector – 89.5 per cent as compared to 86.9 per cent in the public sector.

India TB Report 2024

Tuberculosis

- **Tuberculosis** -- or TB, as it's commonly called -- is a contagious infection that usually attacks the lungs.
- It can also spread to other parts of the body, like the brain and spine. A type of bacteria called **Mycobacterium tuberculosis** causes it.

Eliminating TB by 2025

- Under the **Pradhan Mantri TB Mukht Bharat Abhiyan**-India is committed to **eliminating tuberculosis from the country by 2025**, five years ahead of the global target by the **World Health Organisation (WHO)** i.e. 2030.

Nikshay

- The Central TB Division developed a case-based and web-based system called "Nikshay".
- This helped with the **reporting of all TB cases**. It was scaled up nationally.

India TB Report 2024

- The Union Ministry for Health and Family Welfare also launched the **'TB Harega Desh Jeetega'** Campaign, along with the Survey.

India TB Report 2024

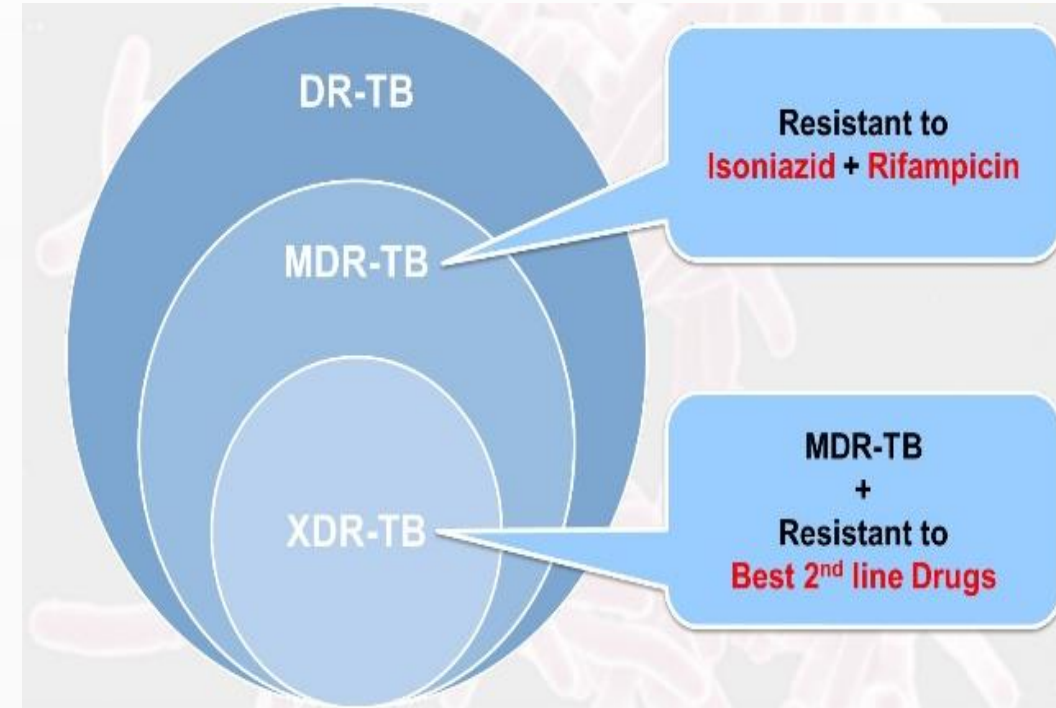
Issues

Multidrug-resistant tuberculosis (MDR-TB)

- Form of TB caused by bacteria that **do not respond to isoniazid and rifampicin, the 2 most powerful, first-line anti-TB drugs.**
- MDR-TB is treatable and curable by using second-line drugs

Extensively drug-resistant TB (XDR-TB)

- Serious form of MDR-TB caused by bacteria that **do not respond to the most effective second-line anti-TB drugs**, often leaving patients without any further treatment options.



India efforts

- India started its TB program with National TB Control Project in 1962
- India launched **Revised National TB Control Program** on the backdrop of WHO recommended DOTS strategy after piloting tests from 1993 to 1996.

Revised National TB Control Programme (RNTCP)

- is a fully Central Sponsored Scheme and works **for free from diagnosis to treatment.**
- It uses DOTS strategy of WHO and all component of STOP TB strategy of WHO.

DOTS: Direct Observatory Treatment Short-course

- It is a key component of the WHO campaign to Stop TB strategy. Indias RNTCP is premised upon DOTS.
- It involves the **volunteers (trained health professionals) based health services to patients, drugs and services** are provided at the doorstep of patients and service provider keeps a track on the diseased.

Key elements:

1. Sustained political and financial commitment
2. Diagnosis by quality ensured sputum-smear microscopy test
3. **Standard short course anti TB treatment given under direct and supportive observation**
4. Regular and **uninterrupted supply of anti TB drugs.**
5. Standardized treatment and reporting

Other Initiatives

The Nikshay Ecosystem

- It is the National TB information system which is a **one-stop solution to manage information of patients and monitor program activity** and performance throughout the country.

Nikshay Poshan Yojana (NPY)

- This scheme is aimed at providing **financial support to TB patients for their nutrition.**

TB Harega Desh Jeetega Campaign

- **Launched In September 2019** it is showcasing the highest level of commitment **for the elimination of TB.**

The Saksham Project

- It is a project of the Tata Institute of Social Sciences (TISS) that has been providing **psycho-social counselling to DR-TB patients.**

Regional Prospective Observational Research in Tuberculosis (RePORT) India initiative:

- It is a bilateral, multi-organizational, collaborative research effort established in 2013 under the **Indo-US Vaccine Action Program(VAP)**. It aims to advance **tuberculosis(TB) research in India.**