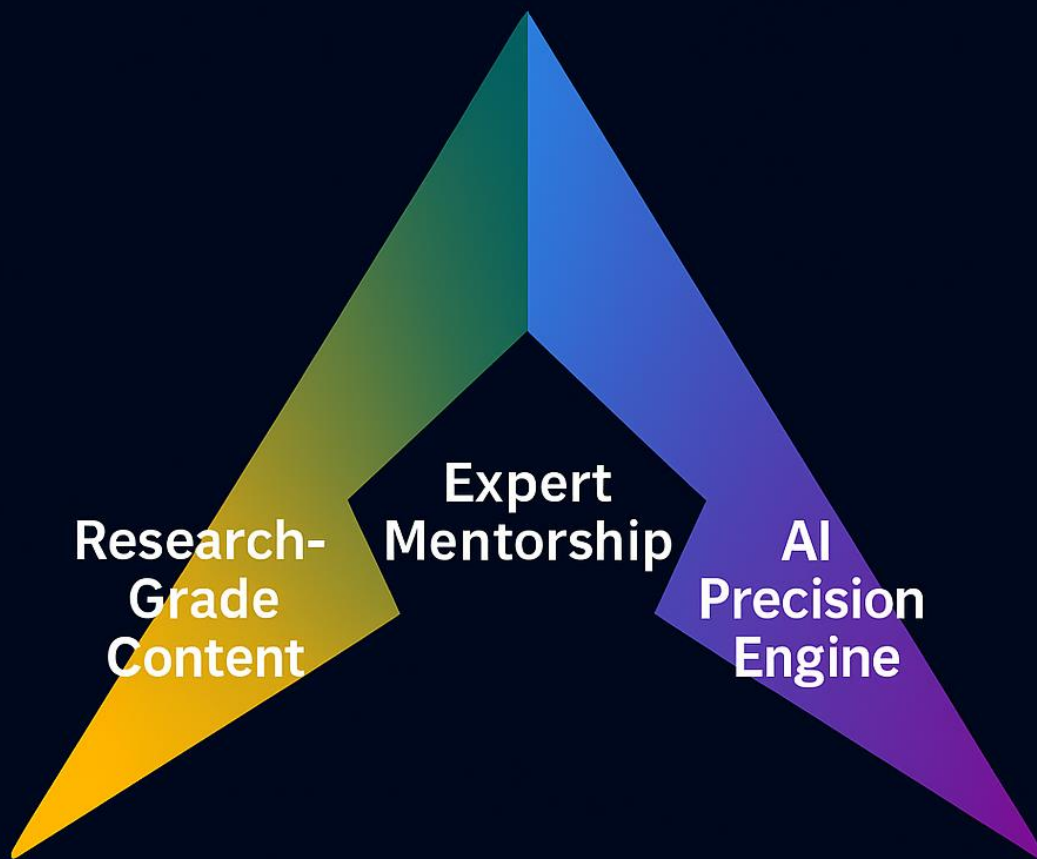


PrepAlpine

The Next-Generation UPSC Institution

Where Research Meets Mentorship & Precision



Preparation Meets Precision

A Next-Generation Learning Institution

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PrepAlpine — Where Research-Grade Content Meets Mentorship, and AI Makes It Personal

PrepAlpine is India's next-generation UPSC institution — built by educationists, retired bureaucrats, IITians, and experienced educators, and powered by a 500+-member technology firm specialising in AI-driven education infrastructure.

We're not another coaching platform — we're a complete preparation ecosystem that unites:

- **Research-Grade Content:**

Every content is crafted and reviewed by civil servants, educators, and scholars, and follows UPSC's Intro–Body–Conclusion format. Content is built from official reports, verified data, and visual pedagogy — flowcharts, frameworks, maps, and comparative tables.

- **Two-Tier Mentorship:**

Interview-qualified mentors and Subject-Matter Experts provide structured strategy, accountability, doubt-solving, and exam-aligned depth — bridging the gap between preparation and performance.

- **AI Precision Engine:**

Developed with our 500+-member AI & EdTech partner firm, the PrepAlpine AI system integrates Retrieval-Augmented Generation (RAG), adaptive MCQ engines, AI-based answer evaluation, and intelligent revision tracking. It continuously identifies each learner's strengths, weaknesses, and learning patterns — ensuring preparation evolves dynamically with every step.

This fusion of research-grade content + expert mentorship + enterprise-grade AI technology has created a credible, scalable, and aspirant-first platform.

Every PrepAlpine module is built not just to inform, but to transform — converting effort into precision and hard work into predictable progress.

We're reimagining UPSC preparation as a research-led, mentor-guided, AI-personalised journey that adapts to every aspirant.

PrepAlpine — From Aspirant to Authority. Lead the State, Not the Struggle.

DAILY CURRENT AFFAIRS DATED 21.11.2025

GS Paper III: Economics

1. India's Fisheries and Aquaculture: Expanding Horizons within the Blue Economy

a. Introduction

India's fisheries and aquaculture sector has undergone a remarkable transition—from subsistence-level, artisanal operations to a modern, technology-rich industry that now supports national nutrition, rural employment and export-led growth. This evolution has positioned fisheries as a core pillar of India's emerging Blue Economy, which seeks to harness marine and aquatic resources in an ecologically balanced and economically inclusive manner. As the sector grows, its long-term resilience will depend on integrating innovation with sustainable ecosystem management.

b. Why the Sector Matters

i. Nutritional and Social Importance

- Fish provides affordable, high-quality animal protein essential for nutritional security.
- More than three crore Indians depend on fisheries for livelihoods, including large numbers of women in processing and post-harvest work.
- Fishing communities rely on the sector for daily income, local employment and socio-economic stability.

ii. India's Global Position

- India ranks among the world's leading fish producers and stands second in aquaculture production.
- Total fish output exceeds seventeen million tonnes annually, with aquaculture contributing more than ten million tonnes.
- Inland ponds, tanks, brackish water systems and reservoir-based cage culture have become crucial engines of rural growth.



c. Drivers of Growth

i. Technological Advancements

- Modern hatcheries, improved breeding techniques and nutritional feed have raised productivity.
- Disease surveillance and management systems have improved survival rates.
- Satellite-based advisories now guide safer and more efficient fishing operations.
- Ice plants, cold chains and modern harbours reduce post-harvest losses and enhance export quality.

ii. Government Support

- The Blue Revolution created early momentum for scientific modernisation.
- The Pradhan Mantri Matsya Sampada Yojana advances this through infrastructure creation, value addition and export promotion.
- Extension of the Kisan Credit Card to fishers improves access to timely and low-cost finance.
- Matsya Seva Kendras provide decentralised advisory services.
- Climate-resilient fishermen villages reflect a long-term approach to vulnerability reduction.

iii. Expansion of Aquaculture

- Aquaculture has diversified beyond traditional ponds to brackish water shrimp farms and multi-species tanks.
- Integrated farming models combine fish with agriculture or livestock, optimising land and water use.
- Cage culture in reservoirs offers new livelihood avenues for inland districts.

d. Institutional Architecture

i. National Institutions

- ICAR fisheries research institutes generate new technologies, species-specific improvements and capacity-building programmes.
- The Marine Products Export Development Authority enhances processing standards, certification and market access.
- The National Fisheries Development Board supports infrastructure, modernisation and value chain strengthening.
- The Coastal Aquaculture Authority regulates aquaculture practices to ensure environmental compliance.

ii. International Partnerships

- The FAO works with India to improve small-scale fisher safety, promote sustainable aquaculture and upgrade port handling systems.
- FAO support includes developing traceability systems and reducing Illegal, Unreported and Unregulated fishing.
- These partnerships help India align with global sustainability standards.

e. Persistent Challenges

i. Ecological Concerns

- Overfishing and habitat degradation have lowered the regenerative capacity of marine ecosystems.
- Mangrove loss, coral decline and pollution threaten breeding and nursery grounds.
- Climate change alters sea temperatures, intensifies cyclones and disrupts fish migration patterns.

ii. Economic and Social Constraints

- Small-scale fishers lack modern boats, cold storage, quality feed and formal credit.
- Post-harvest losses can reach one quarter of total catch, reducing income and lowering product quality.
- Small processors often struggle to meet global hygiene, traceability and sustainability standards.

iii. Governance Issues

- Illegal and unregulated fishing weakens stock recovery.
- Enforcement of scientific norms remains inconsistent across states.
- Unplanned coastal development disrupts fragile coastal ecosystems.

f. The Path to Sustainability

i. Sustainable Fishing Practices

- Implementing scientific stock assessments and seasonal fishing bans helps rebuild marine populations.
- Protecting breeding and nursery grounds is essential for long-term productivity.
- Adoption of selective, less destructive gear reduces by-catch and protects biodiversity.

ii. Sustainable Aquaculture

- Expansion must be based on low-impact systems and strong water-quality management.
- Diversifying into multiple species reduces the risks associated with shrimp dependency.
- Training in feed management, biosecurity and environmentally sound practices is critical.

iii. Strengthening the Value Chain

- Modern landing centres, cold chains and processing units reduce waste and support exports.
- Digital traceability systems will become essential for accessing premium global markets.
- Better logistics and hygiene standards improve both domestic supply and international competitiveness.

iv. Empowering Small-Scale Fishers

- Inclusion through credit, insurance and social security schemes strengthens resilience.
- Skill development and women's cooperatives enhance diversification and income stability.
- Community-based resource management promotes stewardship and reduces conflict.

Conclusion

India's fisheries and aquaculture sector now stands at an inflection point. It has achieved global prominence, but the future lies in maintaining a careful balance between economic expansion and ecological responsibility. With sustained policy support, widespread adoption of modern technologies and deeper international cooperation, India can build a fisheries system that is productive, inclusive and climate-resilient. The health of marine ecosystems and the welfare of fisher communities are fundamentally interlinked, and the success of India's Blue Economy depends on nurturing both with equal commitment.

GS Paper III: Science and Technology

2. Indigenous Gene Editing Therapy for Sickle Cell Anaemia: The Emergence of Birsa-101

a. Introduction

India has taken a historic leap in biotechnology by creating an indigenous gene editing platform capable of correcting genetic disorders with the precision of advanced global systems such as CRISPR. Using this platform, Indian scientists have developed a one-time curative therapy for sickle cell anaemia, named Birsa-101 in honour of Birsa Munda. This choice reflects a deep social message: sickle cell disease disproportionately affects many tribal communities across central and eastern India.

The true breakthrough lies not only in scientific excellence but also in the possibility of providing a treatment that is dramatically more affordable than global therapies, some of which can cost more than eighteen crore rupees per patient.

b. Understanding Sickle Cell Anaemia

Sickle cell anaemia is a genetic blood disorder that changes the shape and behaviour of red blood cells.

i. Nature of the Disorder

- In healthy individuals, red blood cells are soft, round and flexible, enabling smooth flow through blood vessels.
- In sickle cell anaemia, the cells become stiff and curved like a sickle.
- These distorted cells get stuck in narrow vessels, causing severe pain episodes, chronic anaemia, recurrent infections and organ damage.



ii. Genetic Basis

- The condition is caused by a mutation in the haemoglobin gene.
- This defective haemoglobin forces the cells to change shape, triggering long-term clinical complications.

c. How Birsa-101 Works

Birsa-101 uses advanced gene editing to directly repair the mutation responsible for sickle cell anaemia.

Step-by-Step Process

- Doctors extract stem cells from the patient's bone marrow.
- Scientists apply the indigenous gene editing tool to precisely correct the mutation.
- These corrected stem cells are then infused back into the patient.
- Once inside the body, they start producing healthy red blood cells that gradually replace diseased ones.

The therapy is therefore curative, not repetitive, eliminating the need for lifelong transfusions or medicines.

d. India's Approach Compared to Global Therapies

i. Key Differences

- International therapies like Casgevy are based on the original CRISPR-Cas9 system and are designed mainly for Western genetic patterns.
- They are extremely expensive, limiting their accessibility.

ii. India's Distinct Edge

- Birsa-101 is built on a fully indigenous platform, reducing foreign royalty payments.
- It is tailored to Indian genetic variations.
- It is designed to be significantly more affordable and accessible, particularly for tribal communities where disease prevalence is high.

e. The Science Behind CRISPR-like Editing

Gene editing tools act like precise molecular scissors that locate, cut and help repair faulty genes.

i. Fundamental Principle

- They identify the exact location of a genetic defect.
- They introduce a controlled cut in the DNA.
- The cell's own repair machinery corrects the sequence.

ii. India's Innovation

- India's indigenous system follows the same core principle.
- It focuses on affordability, precision and minimising unintended genetic changes, known as off-target effects.

f. Why Birsa-101 Matters for India

i. Public Health Significance

- India has one of the world's largest sickle cell-affected populations.
- The burden is concentrated in states such as Jharkhand, Chhattisgarh, Odisha, Madhya Pradesh and Maharashtra.
- The disease reduces productivity, increases hospitalisation and affects quality of life.

ii. Strategic National Importance

- Birsa-101 signals a major leap in India's biotechnology capabilities.
- It promotes scientific self-reliance and leadership in affordable genomic medicine.
- It demonstrates how laboratory innovation can be turned into a large-scale public health solution.

g. Challenges Ahead

i. Scientific and Technical Hurdles

- Ensuring complete safety and minimising off-target effects requires extensive trials.
- Manufacturing facilities for gene therapy demand high precision and skilled manpower.

ii. Public Health Barriers

- Large sections of the population carry the sickle cell trait unknowingly due to poor screening.
- Even a low-cost therapy may remain inaccessible without state support for vulnerable households.

h. Way Forward

i. Strengthening the Ecosystem

- Phased safety trials and strict regulatory monitoring are essential.
- Screening networks must be expanded, especially in tribal regions.
- Public financing and targeted subsidies should ensure equitable access.

ii. Capacity and Awareness

- Medical colleges and regional centres must train specialised teams to handle gene editing protocols.
- Awareness campaigns should promote early testing and reduce stigma.

Conclusion

Birsa-101 represents a defining moment in India's scientific and public health journey. By delivering an indigenous and potentially curative therapy for sickle cell anaemia, India has shown that high-end genetic technologies can be adapted to local needs and made accessible to the communities that need them the most. If implemented with safety, affordability and awareness at the core, Birsa-101 can become a landmark model of compassionate and equitable healthcare, transforming lives and showcasing India's growing leadership in biotechnology.

GS Paper III: Science and Technology

3. Pharmacogenomics: Understanding How Genes Shape Our Response to Medicines

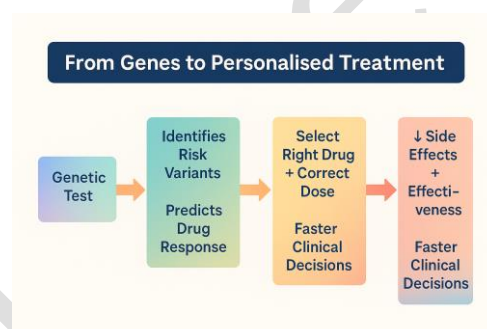
a. Introduction

Pharmacogenomics is an emerging branch of science that studies how a person's genetic makeup influences the way medicines act in the body. Traditional medicine often assumes that most patients will respond similarly to a drug. In reality, drug responses vary widely: some patients improve quickly, others show little benefit, and a few experience harmful side effects even at recommended doses. Pharmacogenomics aims to replace this trial-and-error process with personalised medicine, where the right drug and the safest dose are chosen based on an individual's genetic profile.

b. Why Do Individuals React Differently to the Same Drug?

i. Role of Genes in Drug Processing

- Medicines are broken down, transported and eliminated by biological pathways controlled by genes.
- Variations in these genes change how fast or how slowly a medicine is processed.
- These differences influence a drug's strength, duration in the body, and potential toxicity.



ii. Importance of Cytochrome P450 Enzymes

- Many common medicines are metabolised by the cytochrome P450 enzyme family.
- These enzymes differ among individuals due to inherited genetic variants.
- People may metabolise drugs slowly, normally or very quickly.
- Slow metabolism can cause harmful drug accumulation, while fast metabolism may make the medicine ineffective.

c. Why Pharmacogenomics Matters

i. Clinical Advantages

- It reduces the risk of severe side effects by identifying unsafe drugs for certain genetic profiles.
- It increases the chances that a chosen medicine will work effectively.
- It helps avoid lengthy trial-and-error cycles during treatment of chronic conditions.

ii. Broader Healthcare Benefits

- Adverse drug reactions cause many hospital admissions worldwide.
- A significant proportion of these events can be prevented with genetic insights.
- Pharmacogenomics strengthens the global shift towards precision medicine, where therapies are tailored to individuals.

d. Illustrative Examples

i. Warfarin for Blood Clot Prevention

- Warfarin requires precise dosing to prevent dangerous bleeding.
- Variations in two key genes determine how strongly a person reacts to the drug.

- Genetic testing helps doctors prescribe the safest and most effective dose.

ii. Clopidogrel for Heart Patients

- Clopidogrel must be activated in the liver before it can prevent clots.
- This activation depends on a specific enzyme that varies genetically.
- Patients with reduced-function variants fail to produce enough active drug and remain at risk of heart attacks.
- In such cases, alternative medicines are safer.

iii. Psychiatric Medicines

- Many antidepressants and antipsychotics show wide variation in effectiveness and side effects.
- Genetic testing identifies patients who may not respond or may develop severe reactions.
- This improves treatment outcomes in mental health.

iv. Cancer Treatment

- Modern oncology routinely analyses the genetic features of tumours.
- Targeted drugs are chosen based on specific mutations.
- This increases precision and reduces unnecessary toxicity.

e. Challenges in Widespread Adoption

i. Knowledge and Capacity Gaps

- Many clinicians are not extensively trained in interpreting genetic reports.
- Testing laboratories are unevenly distributed across the country.
- Insurance coverage for genetic tests remains limited.

ii. System-Level Challenges

- Drug labels do not always give clear directions on genetic impacts.
- Hospitals need electronic systems to store and use genetic data during prescribing.
- As a result, most clinical practice still relies on standard dosing rather than personalised treatment.

f. The Future: Moving Towards Pre-Emptive Testing

i. From Reactive to Proactive Care

- Today, genetic tests are usually conducted only after a patient experiences complications.
- The future lies in pre-emptive testing—a one-time genetic analysis performed early in life.
- Once stored in a patient's digital medical record, this information can guide treatment for a lifetime.

ii. Benefits of Pre-Emptive Approaches

- Doctors can choose safer medicines from the start.
- Overall treatment becomes faster, more predictable and more effective.
- This approach represents the core philosophy of precision medicine.

g. Why Pharmacogenomics is Significant for India

i. High Burden of Chronic Diseases

- India faces large numbers of patients with heart disease, diabetes, cancers and mental health disorders.
- These conditions require long-term medication, where genetic variation strongly influences treatment outcomes.

ii. Reducing Adverse Drug Reactions

- Many hospital admissions in India stem from preventable drug reactions.
- Pharmacogenomics can significantly reduce these events and improve patient safety.

iii. Alignment with Digital Health Initiatives

- India's expanding digital health ecosystem supports the integration of genetic data.
- This enables personalised, technology-driven healthcare at scale.

Conclusion

Pharmacogenomics brings together genetics and medicine to build a safer, more accurate and more patient-centred healthcare system. By understanding how genes influence drug responses, clinicians can prescribe treatments tailored to each individual rather than relying on average responses. As India advances towards digital and precision-focused healthcare, the integration of pharmacogenomics will be essential. It marks a foundational step in creating a future where medical care is not only effective but also deeply personalised and preventive.

Reader's Note — About This Current Affairs Compilation

Dear Aspirant,

This document is part of the PrepAlpine Current Affairs Series — designed to bring clarity, structure, and precision to your daily UPSC learning.

While every effort has been made to balance depth with brevity, please keep the following in mind:

1. Orientation & Purpose

This compilation is curated primarily from the UPSC Mains perspective — with emphasis on conceptual clarity, analytical depth, and interlinkages across GS papers.

However, the PrepAlpine team is simultaneously developing a dedicated Prelims-focused Current Affairs Series, designed for:

- factual coverage
- data recall
- Prelims-style MCQs
- objective pattern analysis

This Prelims Edition will be released separately as a standalone publication.

2. Content Length

Some sections may feel shorter or longer depending on topic relevance and news density. To fit your personal preference, you may freely resize or summarize sections using any LLM tool (ChatGPT, Gemini, Claude, etc.) at your convenience.

3. Format Flexibility

The formatting combines:

- paragraphs
- lists
- tables
- visual cues

—all optimised for retention.

If you prefer a specific style (lists → paras, paras → tables, etc.), feel free to convert using any free LLM.

4. Monthly Current Affairs Release

The complete Monthly Current Affairs Module will be released soon, optimized to a compact 100–150 pages — comprehensive yet concise, exam-ready, and revision-efficient.

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