CURRENT AFFAIRS 2020

Science & Tech.

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CHIM study

Context

ICMR and the DBT plan to introduce controlled human infection model (CHIM) studies in India.

What is CHIM study?

It is a research method in which healthy people are infected with a selected strain of an infectious virus or bacteria in order to test a vaccine.

Difference with clinical trial?

A clinical trial is defined as the systematic study of new drug(s) in human subjects with the objective of determining the safety and efficacy of the new drug.

Need/Advantages

1. Pathological studies
2. Principle of no harm to animals
3. Reduced costs & easier licensing
4. Improving local efficacy of drugs
5. Vaccine development
6. International Ethics
7. Ineffective traditional vaccine research

Concerns/Disadvantages:

1. Certainty of harm in CHIM studies.
2. A safer, well characterised strain will lose some semblance to the real "challenge" organism.
3. Possible spurt in trials
4. Joining multiple trials & withholding information
5. Consent to be harmed
6. Loophole in the Drugs and Cosmetics Act, 1940
8. Contrary to the established principles

Experts Voice:

1. The Alliance for Human Research Protection (AHRP) has called the proposed studies on human volunteers in India, "a vaccine experiment atrocity".
2. Justice R.M. Lodha commented about these trials saying, "human beings are being treated like animals".

Way Forward

1. Objectivity and clarity
2. Systematic public engagement, taking the public into confidence, transparency at every stage, addressing ethical and social concerns, and a clear regulatory framework specific to CHIM.
3. Other ethical concerns
4. Revision of existing guidelines

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Edge Computing

What is it?

Edge computing is the practice of processing data near the edge of your network, where the data is being generated, instead of in a centralised data-processing warehouse.

Difference with cloud computing

It is a centralized network of remote servers which provide on-demand availability of computing and storage resources over an internet connection.

Uses/Advantages

1. Reducing internet bandwidth usage
2. Reduces latency
3. Decrease in server resources and associated cost
4. Reduces ecological footprint
5. Newer functionalities
6. Inclusion and accessibility
7. Increases data security
8. Good digital experience for consumer

Concerns

1. Increases attack vectors
2. Requires more local hardware
3. Incomplete data availability for companies
4. Potential loss or data corruption

Applications

1. Self-driving vehicles
2. Traffic management
3. Power management with smart grids & smart meters
4. Safety monitoring in remote oil and gas rigs
5. Mobile app data management
6. Edge video orchestration

Related Terms

1. Fog computing
2. Cloudlets

Science and Technology – Eminent Personalities

1. Vikram Ambalal Sarabhai – was an Indian Physicist and Industrialist. He has immense contribution in development of space research and nuclear power in India.

- 1947 – establishment of Physics Research Laboratory, Ahmedabad. Cosmic Rays was the first field of research at the laboratory which functioned initially from Sarabhai's residence in Ahmedabad.
- 1947 - founded the Ahmedabad Textile Industry's Research Association in 1947.
- 1961 – one of the founding members of Indian Institute of Management, Ahmedabad.
- 1962 – persuaded government to setup Indian National Committee for Space Research (INCOSPAR). He was the first chairman of the committee. INCOSPAR in 1969 became the Indian Space Research Organisation.
- 1963 – helped setup Thumba Equatorial Rocket Launching Station, India's first rocket launching site.
- 1966 - appointed chairman of the Atomic Energy Commission of India post the death of Homi j Bhabha. Sarabhai was largely responsible for the establishment and development of India's nuclear power plants. He laid the foundations for the indigenous development of nuclear technology for defense purposes.
- 1973 – His endeavors ensured establishment of Satellite Instructional Television Experiment (SITE) in 1975 after his death. It opened the channel for cable televisions in India.
- 1975 – He initiated the work on India's first satellite "Aryabhatta", which was launched in 1975 post his death.

Sarabhai was awarded two of India's highest honours, the Padma Bhushan (1966) and the Padma Vibhushan (awarded posthumously in 1972).

2. Homi J. Bhabha – was an Indian Physicist who is considered as the "Father of the Indian Nuclear Program".

- 1940 - join the Indian Institute of Science, where he founded the Cosmic Ray Research Institute.
- 1945 - founded the Tata Institute of Fundamental Research, where initial research for India's nuclear program began
- 1945 - founded a nuclear research center at Trombay. It was later renamed the Bhabha Atomic Research Centre (BARC) by Indira Gandhi after his death.
- 1948 – Appointed chairman of the Atomic Energy Commission instituted by the government of India
- 1955 - organized the first UN Conference on the Peaceful Uses of Atomic Energy.
- 1960 – 63 – was President of the International Union of Pure and Applied Physics

GENOME SEQUENCING

genome → is all genetic material of an Organism. i.e DNA & RNA

Defenition: determining the complete DNA sequence of an organism genome.

Significance of Genome Sequencing

1. **Healthcare:-**
   - helps in determining the origin of epidemic.
   - helps in delivering personalised medicine
   - determine gene linked disease
   - help in better understanding of diseases like Cancer
   - helps in ~~faster~~ and ~~efficient~~ diagnostics (Next Generation Sequencing labs)
   - help understand drug efficacy

2. **Agriculture:-**
   genome sequencing of crops can help in understanding their susceptibilities to blights, rusts and pests

3. **Evolutionary Studies :-** help study and map spread of migrations of range of life forms.
also, help define diversity of a region.

Concerns with genome sequencing

1. accuracy and reliability of genome sequencing unknown.
2. knowledge on role of most of genes is unknown.
3. lack of skilled manpower to interpret genetic data.
4. information from genome sequencing may be something which generates negativity for eg. funding a terminal disease in genome sequencing.
5. Will involve extensive and private data — needs a policy for the same.

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GENE EDITING

Defention deliberate alteration of selected DNA sequence in a living cell.

editing DNA ⟶ altering removing or adding nucleotides to the genome.

nucleotides ⟶ building blocks of nucleic acid (DNA or RNA)

eg. **Bt Cotton** — gene from bacterium *Bacillus Thuringiences*. added to cotton genome

↓

help resistance against pink bollworms

Application

1. Healthcare :—

- investigate models of human disease
- precision medicine
- somatic gene editing
- embryo alteration
- bio medicines

2. Agriculture
   - pest control
   - agricultural breeding
   - third generation biofuels
3. Resurrecting extinct species.
4. Sterility in mosquitoes and other vectors.

Concerns with gene editing

1. Commercialisation — designer babies
2. Creation of superior race — unconventional warfare
3. against the rules of nature
4. affect evolution in negative way
5. ecological — alter and may destroy food webs
6. Social — disrupt agriculture enable new weapons of mass extinction

7. resistance in vectors against gene drive.

Ethical Concerns

1. welfare of future person.
2. Intergenerational equity
3. Should not increase disadvantage discrimination and division in the society.

FARM MECHANISATION

Current Status of Farm Mechanisation in India — 40 — 45%

lowest mechanisation at planting and sowing level
highest mechanisation at Harvesting and Threshing level.

Benefits of Farm Mechanisation

1. Increase in agricultural production
2. Saving at input level
3. Increased agriculture efficiency
4. Solves the problem of high cost labour
5. Social benefits
   - conversion of uncultivable land to agricultural land
   - decreased burden on women
   - Safety in farm practices
   - encourage youth
6. Sustainable agriculture

Challenges with Farm Mechanisation

1. Small and scattered land holdings
2. High cost of equipments
3. 'Tractorisation' of Agriculture
4. Difficult procurement process
5. Subsidy → not requirement based
6. High Dependent population
7. Poor Safety Standards
8. Lack of awareness among farmers.

Farm Mechanisation - Way Forward

1. customised equipment
2. Promotion of cooperative farming
3. Bringing in more funds via priority sector lending of commercial banks and CSR

4. Agriculture Machinery Banks
5. Promotion of Contract farming
6. Improve quality of agri value chain, better income realisation.
7. Create awareness via CSR initiatives and compulsory demonstration of machinery.

Government Interventions

1. Sub Mission on Agricultural Mechanisation
   - part of National Mission on Agriculture Extension & Tech
   - promote the usage of farm equipment.
2. National Food Security Mission
   - provision for assistance upto 50% the cost of machinery.
3. Rashtriya Krishi Vikas Yojana
4. Mission for Integrated Development of Horticulture.

COMMERCIALISATION OF SPACE

INSPACE (Indian National Space Promotion and Authorisation Centre)

- separate vertical under Department of Space
- permitting and regulating activities of private entities in space sector
- national nodal agency for hand holding and promoting private industry in space sector

Department of Space

- ISRO — R&D activities, launches & exoplanetary missions
- New Space India Ltd. (NSIL) — commercially exploit R&D work of ISRO. has moved from supply driven to demand driven
- Antrix — marketing arm of ISRO

Q:-
So, why we need a new entity?

why commercialisation of space?

private players — already involved as supplier of parts & components.

1. global space economy — $300 billion
   India's share — 3%
   need to increase the share.

2. Global space economy
   - 2% — rocket, satellite launches
   - 95% — demand for satellite based services & ground based system.

   private players will help deliver these in faster & efficient manner

3. will help ISRO to become a facilitator and focus heavily on R&D, exoplanetary mission and Strategic launches.

WEAPONISATION OF SPACE

Weaponisation of space different from militarisation of space

Space is heavily militarised but not weaponised.

Militarisation — use of space tech in conventional war

Weaponisation — placement of weapons in space
attacking targets in space from weapons stationed on earth

"Space is the battleground"

Why a race for weaponisation of space?

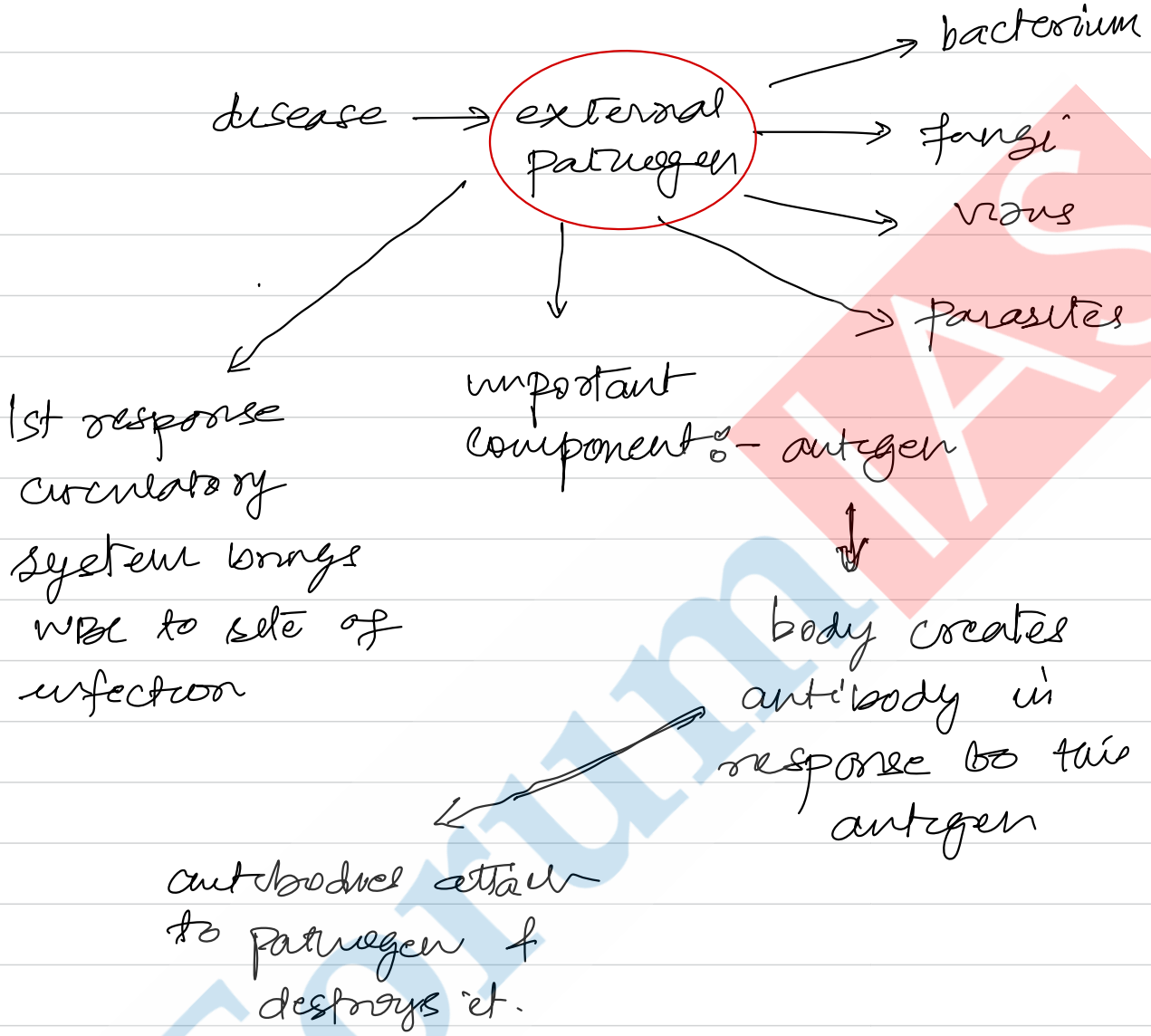
1. deterrent against ICBM missiles.
2. protection of assets in space like satellites
3. overall global supremacy.

Consequences

1. hurts commercial activities of space.
2. create barriers for scientific research
3. issue of space debris and threat to other satellites. LEO debris cause damage to people and person.
4. capturing of radio frequency and orbital slots.

VACCINE DEVELOPMENT

Context :- race to develop vaccine to fight Covid - 19.



Vaccine →

- provides controlled exposure to pathogen (weakened or inactive)
- trains and strengthen the immune system
- quickly and effectively fight the disease

Need for a Vaccine

1. protection from dangerous diseases
2. herd immunity.
3. control epidemics and pandemics
4. help limit drug resistance
5. most effective health intervention

Phases of Vaccine Development

- exploratory
- Pre Clinical
- Clinical Trials
- approval
- manufacturing
- Quality

exploratory – identification of biological pathogen and its genetic sequencing

pre-clinical – testing on animals. step skipped in case of covid

approval – formal approval from regulatory authority.
In case of India it is CDSCO
easier to get approval – if earlier similar vaccine is present.

Emergency Use Authorisation (EUA)

permission to use even before final formal approval

Idea known and potential benefits outweigh known and potential risks.

India **doesn't have any provision or process** defined for EUA.

Types of Vaccine

- Pathogen based
  - → live attenuated
  - → inactivated
- nucleic acid
  - → DNA
  - → mRNA

Vaccine Nationalism

pre-purchase agreement → even before end of final stage of human trials.

Challenges

- poor and weak countries left behind
- against creation of herd immunity in all regions of world

Vaccine Diplomacy

India is largest manufacturer of vaccine in the world.

earlier example of Vaccine Diplomacy

India provided HCQ to 55 countries during the initial phase of Covid 19.

Vaccine Diplomacy - Methods

- free distribution - immediate neighbour
- heavily subsidised - for poor & weak countries
- India's commitment to equitable distribution
- Supply chain guarantee
- trial of Indian Vaccine candidates in other countries
- coproduction of Indian Vaccine with other nations

Clinical Trials

conducted in 3-4 phases :-

phase 1 — 20 to 100 healthy adult volunteers

- safety of the candidate vaccine
- type and extent of immune response

phase 2 — 100s of people

- impact of vaccine on different age groups
- immunogenecity
- proposed doses
- scheduled immunisation
- method of delivery
- conducted in placebo-controlled environment

phase 3 — 1000s of people

- determine random side effects
- check for vaccine efficacy.

Vaccine efficacy :- % reduction in disease incidence in a vaccinated group compared to an unvaccinated group.

Clinical Trials in India

Governed in India by three laws :-

- Drugs & Cosmetics Act, 1940
- Medical Council of India Act, 1956
- Central council for India in Medicine Act, 1970

Issues with Clinical Trial

- Subjects – low income & vulnerable
- lacking consent & voluntary consent
- lack of ethics committee as well as trained professional on ethics committee
- lack of transparency & accountability
- lack of international standard

Ethical Concerns

- protection of subjects
  - safety
  - consent (informed)
  - voluntary agreement
  - privacy
- Accountability & Transparency
  - regulation
  - ethics committee
- Data in public domain
  - research
  - trial details

India — a destination of choice for Clinical trials

- wide genetic pool
- incidence of large number of diseases
- easy availability of subjects
- low cost.

Way Forward

Ranjit Roy Choudhary Committee

1. clinical trials – accredited centres
2. ethics committee – accredited
3. principal investigator – accredited
4. trial sites proper infra & facilities
   oversight mechanism
   documented procedures

concrete steps taken

1. permission from DGCI
2. Approval from Ethics Committee
3. ICMR registration mandatory
4. mandatory registration at Clinical Registry in India
5. audio visual recording of the consent taking process
6. Compensation

1. clinical trials under R 71
2. full disclosure to subject
3. right to withdraw at any stage

BLOCKCHAIN TECHNOLOGY

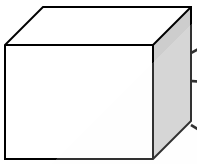
Definition:-

- Open & distributed ledger
- Type of a database
- Data in blocks chained together chronological order

Characteristics of Blockchain

- Decentralisation
- Persistency
- Anonymity
- Adaptability

Data Block



- Data
- Hash (fingerprint)
- Hash of previous block

What makes blockchain secure?

- Proof of work
- Smart Contracts
- P2P Network Consensus

APPLICATIONS:-

Financial Sector

Banking

1. Online identies of individuals
2. Financial Inclusions
3. Cross border remittances simplified
4. P2P payment and Lending

Capital Market

1. Trade settlement
2. Commercial paper issuance and trading

Healthcare

1. Patient Record Mgmt.
2. Assist in UHC ,PMJAY
3. Claim processing

Agriculture

1. Supply Chain Management
2. Price realization for farmers and other stakeholders

Governance

1. Foster transparency
2. Efficient service delivery
3. Minimum govt. maximum governance
4. Comprehensive and fair elections
5. Land records
6. Monitoring welfare
7. Protecting IPR
8. Tracking procurement and expenses
9. Health and education data
10. Cyber security

Govt. steps to foster blockchain tech

- Distributed centre of excellence
- Future skills Program
- Natural Mission on Interdisciplinary cyber Physical systems (N M - ICPS)

Blockchain – limitations & challenges

- Complex signature verification
- Attorney consensus
- Storage issue
- Computing power
- Lack of Scalability
- Lack of interoperability
- Data migration issue
- Regulation
- Security - attack of 51%
- Lack of skilled mainframe

Blockchain Bill of Rights -WEF

16 Principles – 4 Categories

1. Transparency & Accessibility
2. Agency & Interoperability
3. Privacy & Security
4. Accountability of Governance

Need:-

1. Risk to user
2. Undermining potential
3. Widening gaps
4. Social impact
5. Financial sector

CRYPTOCURRENCY

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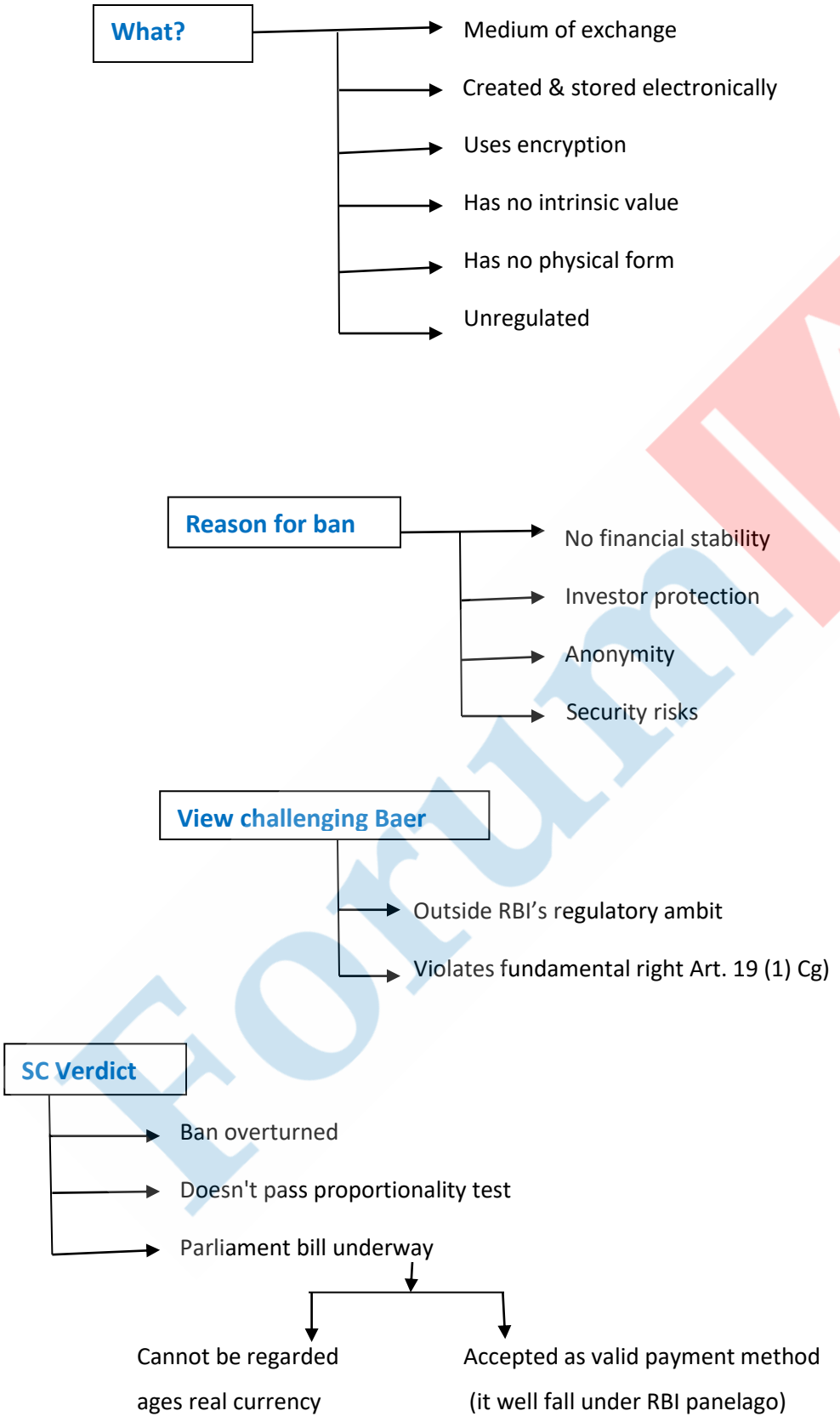

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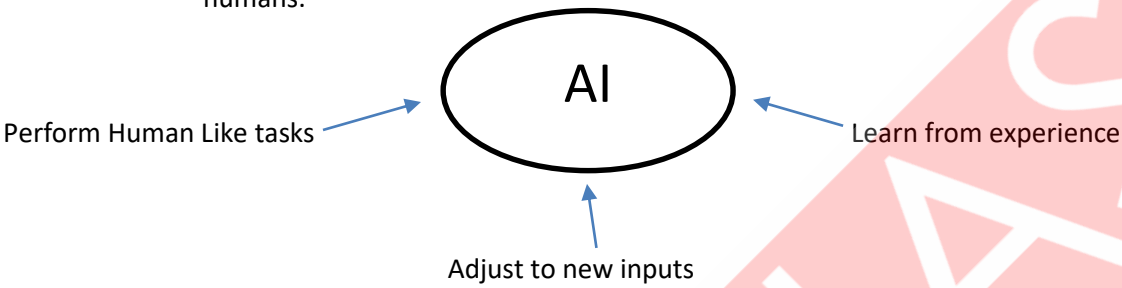
ARTIFICIAL INTELLIGENCE

Definition - Machines that perform tasks which is generally associated with intelligent beings i.e. humans.

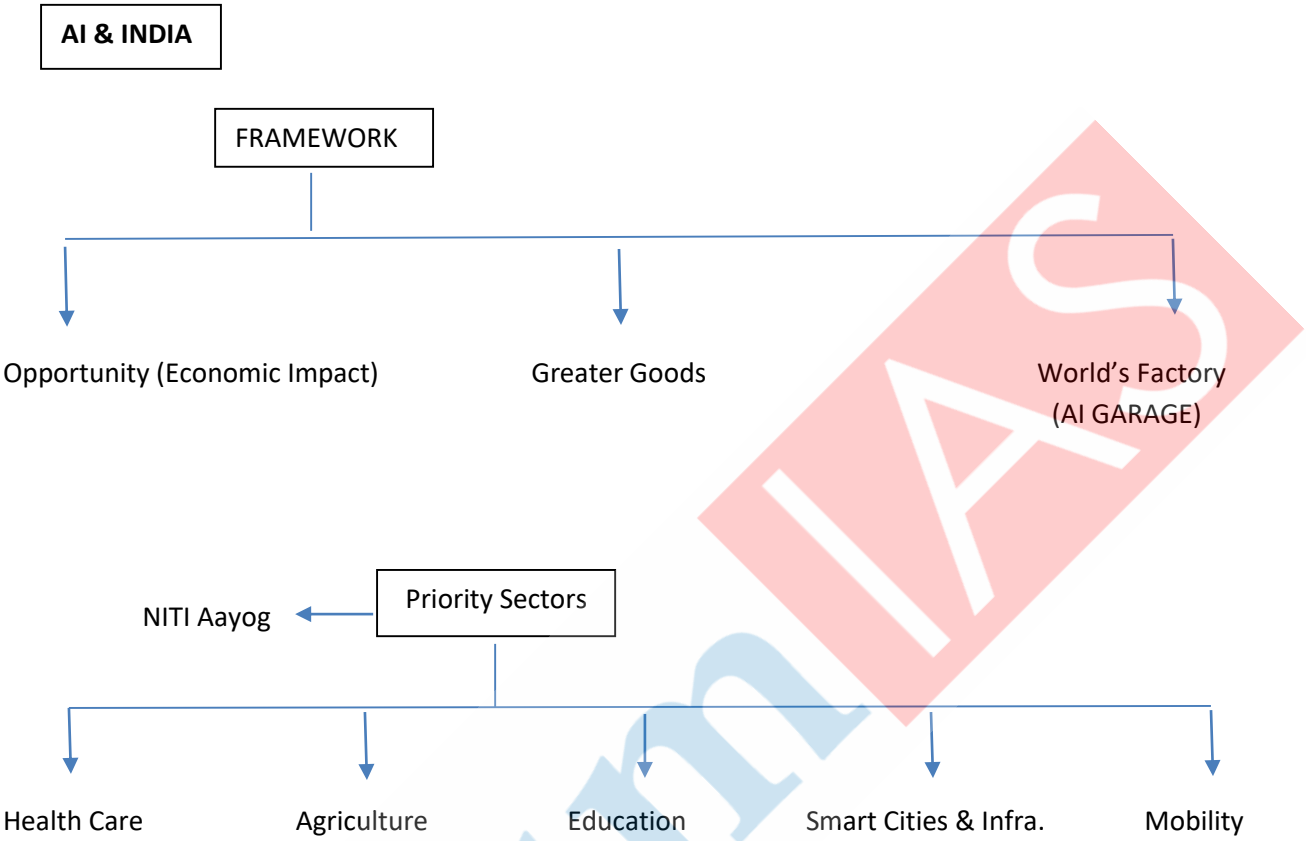


Practical examples of AI

1. Ola, Uber & Google maps – shows transit time, include traffic data
2. Netflix, Youtube – recommendation based on your viewing history
3. Speech Assistant – Siri, Alexa
4. Credit history & loan applications
5. Telegana Government used AI enabled Plate Number verification software to catch violations during lockdown

What has made AI possible?

1. New technologies – DL & ML
2. Computing power
3. Fall in cost of storage data
4. Boom in digitized data



Healthcare

CHALLENGES	How AI can help?
1. Shortage of qualified health care professional	Diagnostics & Early Detection
1. Non Uniform Accessibility to healthcare	Keeping well & life care.
2. Affordability	Treatments to healthcare Decision making
2. Reactive Approach to essential healthcare	Research & Training

"Sick care" to "Time health care"

True Health care and not time health care

Agriculture

Resource intensive Agri Practices led to	**How AI can help?**
1. Land degradation	Precision Farming
2. Reduction in soil fertility	Increasing the share of price realization to farmers
3. Dependence on inorganic fertilizers	
4. Dropping water takes	
5. Pest resistance	

Agriculture suffers from:

1. Poor resource utilisation
2. Low productivity

Education

Challenges Low retention rates poor learning outcomes	**How AI can help?**
1. Multigrade multi-level classrooms	Adaptive learning tools
2. Lack of interactive pedagogy	Intelligent & Interactive tutoring system
3. Ineffective remedies instruction	Predective tools
4. Teacher vacancies , Poo training	Automated rationalization of teacher
5. Low adoption of tech	

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Smart Cities & Infrastructure

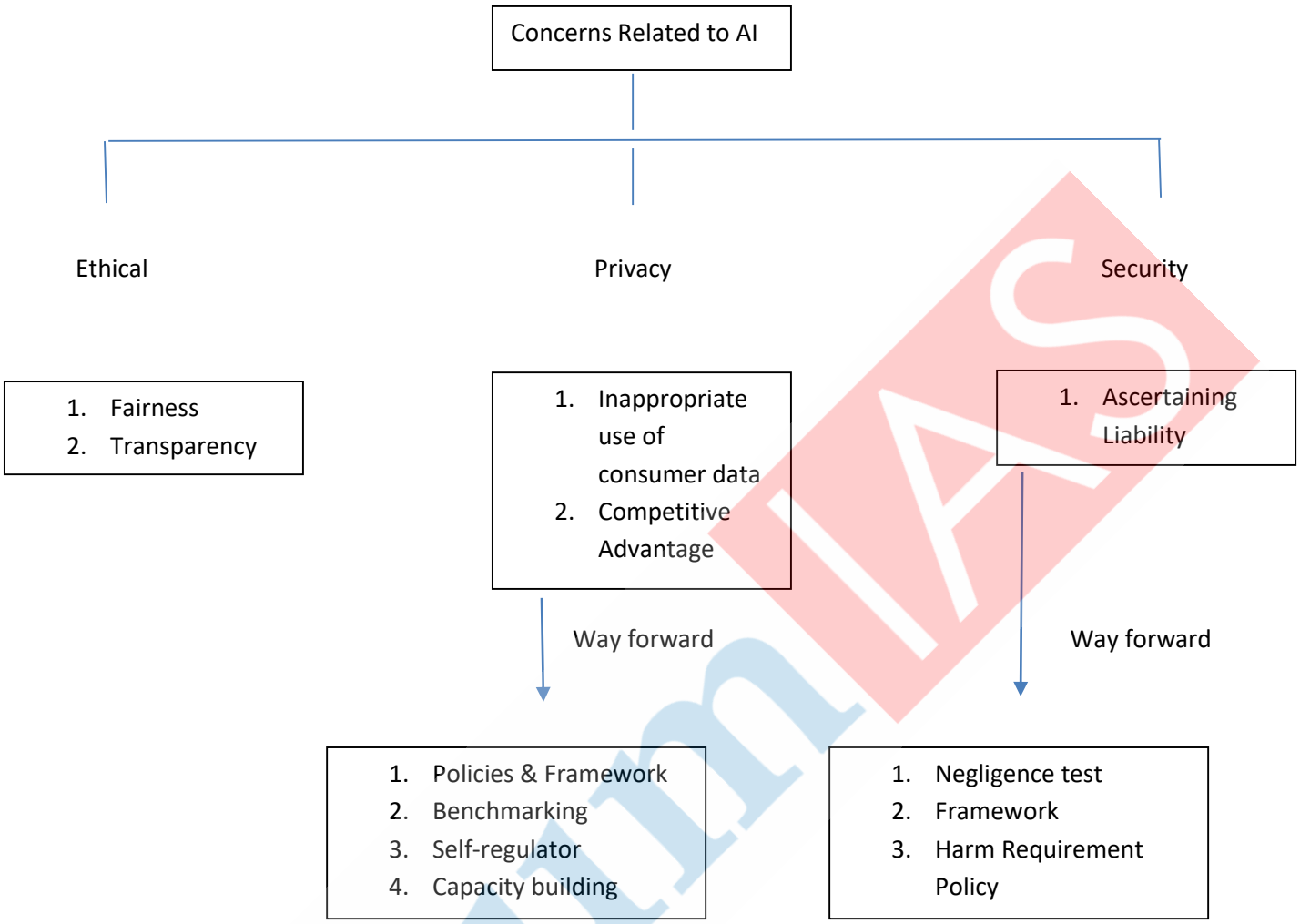
Challenges	How AI can help?
1. Poor urban planning	Smart parks & public facilities
2. Inefficient utility distribution	Smart homes
3. Improved delivery of citizen services	AI driven service delivery
4. Improving public safety	Intelligent safety systems cyber attacks
	Cyber Attacks

Transportation & Mobility

Challenges	How AI can help?
1. Congestion & road accidents	Autonomous trucking
2. Traffic deaths	Intelligent transportation system
3. Lack of pubic transport infra	Travel route / flow optimisation
4. Assisted vehicle tech	AI for railways
5. Sustainable transportation	Community based parking
6. Design on efficiencies in greenfield projects	

India's Readiness for AI

Challenges	How AI can help?
1. Manpower	Workforce Skilling
2. Policies	Framework for promoting AI research
3. Lack of ecosystems	Accelerating adoption
4. Lack of research	National AI Marketplace
5. Unattractive IPR regime	


Concerns Related to AI
Ethical
Privacy
Security
1. Fairness
2. Transparency
1. Inappropriate use of consumer data
2. Competitive Advantage
1. Ascertaining Liability
Way forward
Way forward
1. Policies & Framework
2. Benchmarking
3. Self-regulator
4. Capacity building
1. Negligence test
2. Framework
3. Harm Requirement Policy