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"LIGHT-BASED TOOL THAT COULD CUT COST BY PRECISELY SPOTTING VIRUS"

THIS ARTICLE COVERS "DAILY CURRENT AFFAIRS" AND THE TOPIC DETAILS OF "LIGHT-BASED TOOL THAT COULD CUT COST BY PRECISELY SPOTTING VIRUS". THIS TOPIC IS RELEVANT IN THE "SCIENCE AND TECHNOLOGY" SECTION OF THE UPSC- CSE EXAM.

WHY IN THE NEWS?

Viruses can infect plants, animals, and humans. The virus has the potential to trigger pandemics a virus moves from animals to humans, such as COVID-19, which can lead to significant public health emergencies and substantial economic and social disruptions. Public health experts recommend the **'One Health' strategy** to prevent such outbreaks. This approach involves a **comprehensive and integrated effort to monitor and safeguard t**he health of plants, animals, the environment, and humans simultaneously. **Rapid, simple, and cost-effective methods** for detecting viral infections can significantly contribute to achieving this goal.

WHAT DO YOU MEAN BY A LIGHT-BASED TOOL TO DETECT VIRUSES?

The concept of a "light-based tool that could cut cost by precisely spotting Viruses" refers to the development of innovative diagnostic methods that utilise light to detect and identify viruses. These methods aim to reduce costs associated with traditional diagnostic techniques by leveraging the precision and efficiency of light-based detection. The concept of a "light-based tool that could cut cost by precisely spotting viruses" refers to the development of innovative diagnostic methods that utilise light to detect and identify viruses. These methods aim to reduce costs associated with traditional diagnostic techniques by leveraging the precision and efficiency of light-based detection.

VIRAL INFECTION

- A viral infection can stress cells, altering their shapes, sizes, and features. As the infection progresses and the body becomes diseased, these changes become more pronounced.

- Researchers have translated these cellular changes into detectable patterns to identify infected cells. By infecting pig testicle cells with pseudorabies virus, illuminating them under a microscope, and observing how the changes in the cells affected light distortion, they developed a method to track infection progression.
- Comparing these light distortions with those from healthy cells, they identified a 'fingerprint' unique to virus-infected cells.
- The distortion observed referred to **diffraction patterns**, where light waves spread after passing through narrow openings or around small objects, creating alternating light and dark rings or stripes.
- The fingerprint was based on two parameters: the contrast between these stripes and the inverse differential moment, a mathematical value indicating the texture of the diffraction pattern.
- This method could distinguish between uninfected, virus-infected, and dead cells. Infected cells showed elongated shapes and clearer boundaries, changing the contrast of the diffraction fingerprint and increasing light intensity differences.

LESS TIME, MONEY, AND COMPLEXITY

- Current methods for detecting viral infections in cells are complex. For example, one technique involves isolating infected cells and adding chemical reagents that interact with cell enzymes to produce a colour change, indicating infection.
- The new light-based method was compared with this standard for accuracy, time, and cost. The researchers reported that their method could detect infections as accurately or even more accurately than the standard.
- Moreover, the new method was significantly cheaper, with equipment costs around a tenth of the standard method's $3,000 (₹2.5 lakh). Additionally, the new method takes about two hours to detect infected cells, compared to the 40 hours required by the standard method.

Selection and breeding of superior livestock and poultry species:

- The researchers demonstrated their method by placing cell samples on slides under a microscope and analysing the diffraction fingerprint. Although real-world tests are pending, the low cost and ease of use make this method attractive for those working with animals, such as livestock and pets.
- The tool could help detect viral infections and assist in the selection and breeding of superior livestock and poultry species.

AGAINST THE SPREAD OF VIRUSES:

- Viral outbreaks in animals have significant economic impacts. For instance, a 2018 study reported that bird flu outbreaks in Kerala's Kuttanad region caused losses of ₹23 lakh in 2014, with the government spending ₹5.4 crore to contain the disease.
- A rapid, cost-effective way to detect viral infections could enhance surveillance and reduce costs associated with selecting healthy animals for breeding. Current methods involve expensive DNA-sequencing tools, but the new method offers a simpler, more affordable alternative while still effectively identifying desirable traits in animals.

IMPORTANCE OF LIGHT-BASED TOOL:

- **Cost Reduction:** Light-based tools can significantly reduce costs by eliminating the need for expensive equipment and reagents used in traditional diagnostic methods.
- **Portability and Accessibility**: These tools can be designed to be portable and accessible, making them suitable for use in resource-limited settings, community, and home environments.
- **Rapid Detection**: Light-based methods can provide rapid detection, which is crucial for timely interventions and treatment.
- **High Sensitivity and Specificity**: These tools can offer high sensitivity and specificity, ensuring accurate diagnosis and minimising false positives[1][3].

LIMITATION OF LIGHT-BASED TOOLS IN MEDICAL :

- **Complexity of Sample Preparation**: Many light-based methods require complicated sample preparation processes, such as nucleic acid extraction and separation, which can add complexity and cost.
- **Background Signals**: Optical components used in these methods can generate background signals, which can affect the accuracy of detection.
- **Limited Connectivity**: Some light-based systems may not fully utilise smartphone connectivity, which can limit their ability to process images and provide quantitative results.
- **Limited Commercialization:** Although several light-based tools have been developed, they have not yet been commercialised or widely adopted in clinical settings.

PRELIMS BASED QUESTION:

Q. Consider the following statements:

1. Light-based tools can lead to the development of the vaccine.
2. The virus can be transferred from humans to animals through a process known as reverse zoonotic.

Which of the above statement/s is/are correct/s?

1. 1 only
2. 2 only
3. Both 1 and 2
4. Neither 1 nor 2

Answer: B

MAINS BASED QUESTION:

1. **Spreading of the new virus among and between the species at a very fast pace make more Earth vulnerable to mass extinction. Discuss strategies against the viral disease to make world safer for all living beings.**

Vishal Yadav

PRAVAAH PORTAL

THIS ARTICLE COVERS 'DAILY CURRENT AFFAIRS' AND THE TOPIC DETAILS OF "PRAVAAH Portal.". THIS TOPIC IS RELEVANT IN THE "Economy" SECTION OF THE UPSC CSE EXAM.

WHY IN THE NEWS?

The Reserve Bank of India has introduced three significant initiatives: the PRAVAAH portal, the Retail Direct Mobile App, and a FinTech Repository. These efforts are designed to improve the public's access to the central bank and streamline regulatory approvals and transactions.

WHAT IS THE PRAVAAH PORTAL:

- The Platform for Regulatory Application, Validation, and Authorisation (PRAVAAH) is a centralised and secure online portal designed for individuals and entities to obtain licenses, authorisations, or regulatory approvals for any inquiries made to the RBI. The **key features** available in the portal are including:
  - Apply the application online on the portal.
  - Monitor and keep track of the application/reference status.
  - Address any clarification or query the RBI raises regarding the application or reference.
  - Obtain a decision from the RBI within a specified timeframe.
- This portal will also enhance the efficiency of various processes related to the RBI's granting of regulatory approvals and clearances.
- An individual or organisation can submit up to 60 application forms online, addressing various regulatory and supervisory departments within the RBI.

ABOUT RESERVE BANK OF INDIA:

- The country's central banking institution is the Reserve Bank of India (RBI). It controls the issuance and supply of the Indian rupee and manages the country's main payment systems.
- The RBI was established on April 1, 1935, under the Reserve Bank of India Act of 1934. It was nationalised in 1949 and is now fully owned by the government.
- The Reserve Bank of India operates under the direction of a central board of directors, with appointments made by the Government of India. The current Governor, Shaktikanta Das (as of the last update in 2023), leads the board.

KEY FUNCTIONS OF THE RBI ARE:

1. **Monetary Authority**: The RBI formulates and implements monetary policy to stabilise prices and achieve economic growth.
2. **Issuer of Currency**: It is responsible for issuing and managing currency in India.
3. **Regulator of Financial System**: The RBI regulates and supervises the financial system, including commercial banks and non-banking financial companies, to ensure stability and soundness.
4. **Manager of Foreign Exchange**: It manages the Foreign Exchange Management Act, 1999 (FEMA) and facilitates external trade and payment.
5. **Development Role**: The RBI performs various promotional functions to support national objectives, including developing the agricultural and rural sectors.

MAJOR POLICIES OF RBI INCLUDE:

- **Monetary Policy Committee (MPC)**: This committee sets benchmark interest rates to control inflation and foster economic growth.
- **Liquidity Adjustment Facility (LAF)**: Through LAF, the RBI manages liquidity and short-term interest rates via repo and reverse repo operations.
- **Statutory Liquidity Ratio (SLR)**: The percentage of a bank's net demand and time liabilities must be maintained as liquid assets.
- **Cash Reserve Ratio (CRR)**: The percentage of a bank's total deposits that must be held in reserve with the RBI.

The RBI plays a crucial role in shaping India's economic landscape through its diverse functions and policies, striving to balance economic growth and financial stability.

MAINS PRACTICE QUESTION:

Q. Discuss the RBI's contribution to the development of the financial markets in India. How does the RBI control inflation in the economy?

Amit Pradhan