India and RNA Technologies

What is the issue?

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Clustered regularly interspaced short palindromic repeats **(Crispr)** and its associated protein **(Cas9)** have been generating quite a buzz of late, even resulting in speculation about a new technology race between the US and China.

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What is the significance?

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- Political and strategic implications apart, scientists all over the world are now able to **carry out gene editing at costs much lower** than ever before, and much more accurately.
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- The enhanced tinkering with DNA can be used to achieve end goals as diverse as **enhancing crop quality and disease resistance, treating genetic diseases,** and even addressing the associated risk of **antibiotic resistance** through a Crispr pill that substitutes antibiotics.
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- With the advances in nanotechnology and bioinformatics in place, India can be an attractive destination for a number of multinational pharma companies to either outsource some part of their research or buy the siRNA products or nano-carriers for RNA delivery from India.
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- This polymeric molecule—essential for regulation and expression of genes—has already been the subject of research, in areas such as RNA interference (RNAi) and antisense technology.
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What are RNAi & antisense technology?

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- **RNAi:** It is a gene silencing technology that inhibits protein synthesis in target cells using double-stranded RNA.
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- RNAi has huge significance within the Indian context, considering the deep-seated resistance over the years to Bt cotton and other GM seeds.
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- Recently, GM mustard received regulatory approval from the genetic engineering appraisal committee, only to get stalled later on account of a petition filed before the Supreme Court.
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- So, **RNA-reliant solutions could be a viable alternative.**
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- Also, RNAi technologies are now known to formulate drugs capable of reducing cholesterol levels by half.
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- This technology also finds immense importance in treating acute viral infections like AIDS.
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- **Antisense Technology:** It achieves the same result as RNAi, but only through single-stranded RNA.
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- Antisense technology has shown promising results in **producing a variety of tomato with increased shelf-life** commonly known as **Flavr Savr**.
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- The future could potentially be witness to the use of antisense technology to target cancer.
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What are the constraints?

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- India faces two major challenges hindering progress in RNAi and antisense technologies.
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- **Lack of efficient and targeted delivery vehicles:** While some Indian institutes have developed drug delivery vehicles capable of delivering proteins, much less has been done to develop vehicles capable of carrying silencing reagents such as **small interfering RNA (siRNA).**
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- Though this is one of the objectives of a stand-alone programme on nano-biotechnology, **the research gaps continue to exist.**
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- **Minimal development of silencing reagents:** They ensure significant, specific, consistent and lasting knockdown of the target gene.
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- The drug controller general of India (DCGI) has granted its nod to the first-ever clinical trial of siRNA therapy in India, in 2016.
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- The number of such trials is negligible when compared to the total number of clinical trials in our country.
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What could be done?

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- India, in order to deal with the first constraint, **needs to develop domestic facilities** focusing on nanotechnology-based targeted RNA-delivery product development.
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- Nanotechnology being a multidisciplinary field must evoke cooperation and partnership among government ministries, research organizations, and private sector donors.
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- At all levels of government, there must be **active collaboration with research institutions** in the US, Japan, and other early movers in this space, in terms of the training and development of human resources.
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- Academic institutions and governmental agencies must organize nationwide seminars and symposiums to highlight the importance of nanotechnology in the fourth industrial revolution.
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- In order to address the second challenge, India must **enhance its competence around bioinformatics.**
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- Start-ups in the bioinformatics field must work on developing design algorithms for the development of safer, less toxic and more stable silencing reagents.
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- Sustainable improvements in bioinformatics research would require an **increased number of trained scientists** becoming experts in the discipline.
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