SMART INSULIN

GS3: SCIENCE & TECH

Why in news?

Now, scientists have made a major breakthrough in developing what has been long called the **"holy grail"** diabetes treatments — a "smart" insulin that responds in real time to fluctuations in one's blood sugar level.

DIABETES & TREATMENT

What Is Diabetes?

❖ Diabetes is a disease that occurs when your blood glucose, also called blood sugar, is too high. Glucose is your body's main source of energy. Body can make glucose, but glucose also comes from the food you eat.

❖ Insulin is a hormone made by the pancreas that helps glucose get into your cells to be used for energy. If you have diabetes, your body doesn't make enough—or any—insulin, or doesn't use insulin properly. Glucose then stays in your blood and doesn't reach your cells.

❖ **Risks Factors:** Diabetes raises the risk for damage to the eyes, kidneys, nerves, and heart. Diabetes is also linked to some types of cancer.

Kinds of diabetes:

There are two kinds of diabetes. Both are related to the body's ability to synthesis and react to insulin, the hormone that breaks down sugar in the blood to produce energy.

- **Type 1 diabetes**, which often starts in childhood, occurs when the pancreas do not produce insulin (or enough insulin).

- **Type 2 diabetes** sees the cells of the body develop resistance to insulin, meaning greater amounts are required that what is produced by the pancreas.

- Both conditions are managed by the administration of synthetic insulin. But this poses a fundamental challenge as the blood glucose levels in the body are not constant.

- Blood glucose levels falling too much due to the over dosage insulin in the body can be life-threatening.

- Most patients have to constantly monitor their insulin levels, and adjust doses accordingly.

- For decades, scientists have thus tried to develop **glucose-sensitive insulin therapies**.

- Thus far, the most advanced glucose sensitive systems rely on the molecule being stored somewhere in the body (like in a packet under the skin), and being released based on one's blood sugar level, which is detected by a sensor attached to the body.

Engineering insulin (NNC2215)

✓ Scientists have modified the insulin molecule itself to give it an **"on-and-off switch"** that automatically responds to changing blood

✓ Many patients have to constantly monitor blood sugar levels, adjust insulin dosage.

✓ **The newly developed insulin named NNC2215 comprises two parts**: a *ring shaped structure*, and *a molecule* with a **similar shape to glucose called a** *glucoside.*

✓ When blood sugar levels are low, the ***glucoside binds to the ring***, keeping the insulin in an inactive state to prevent further lowering of blood sugar.

✓ But, as blood glucose rises, the glucoside is replaced by glucose itself, triggering the insulin to shift its shape and become active, helping bring blood sugar levels down to safer ranges.

✓ "The hope is that this will ease the constant challenge of managing blood sugar highs and lows, and improve the physical and mental health of millions of people worldwide with diabetes who rely on insulin therapy."

✓ At the moment, the major problem with NNC2215 is that its activation and impact are not gradual.

✓ The engineered insulin requires a significant glucose spike to be activated, and once it is activated, there is a sudden rush of insulin in the system.
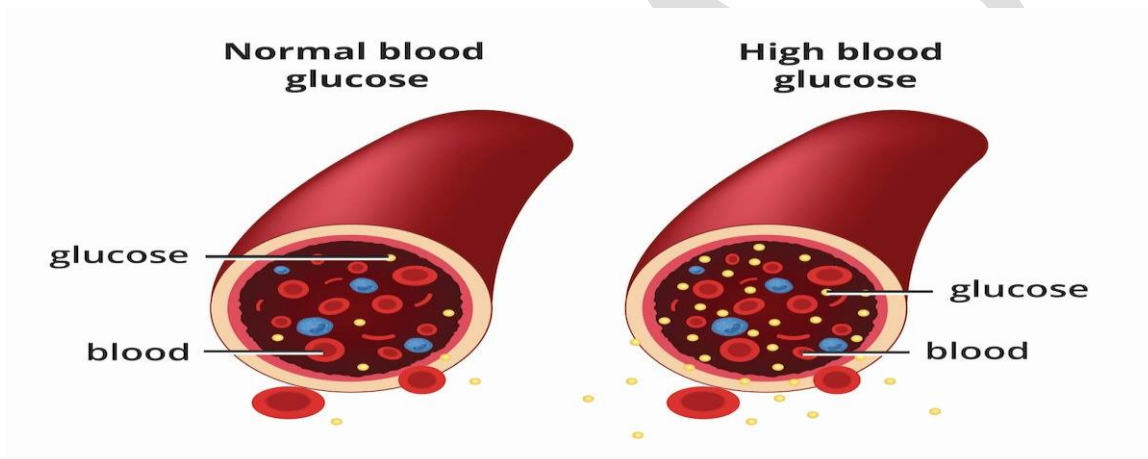
The prevalence of Diabetes in India & world

- India has the second-highest number of diabetes patients in the world, after China.

- There are an **estimated 77 million people** above the age of 18 years suffering from this disease in India.

- Nearly **25 million are pre-diabetics,** which means they are at a high risk of developing this disease shortly.

- It is estimated that the number of **patients with this disease in India will reach 100 million by 2030.**
- Diabetes afflicts more than half a billion people worldwide, and causes nearly seven million deaths a year.
- In recent decades, the prevalence of this disease characterised by elevated levels of blood sugar has skyrocketed around the world

Reasons for High Diabetes in India

o **Diet**: An unhealthy diet with high amounts of calories, refined grains, fat, sugar, and sweetened beverages, and low amounts of fruits and vegetables

o **Physical inactivity**: A sedentary lifestyle that leads to insulin resistance

o **Obesity**: A risk factor for diabetes that occurs at a lower threshold in India than in other countries

o **Urbanization**: A rise in living standards and the availability of cheap, calorie-rich foods

o **Stress and depression**: Mental health factors that can contribute to diabetes

o **Environmental pollutants**: Exposure to air pollution or other toxic chemical substances

o **Alcohol**: Excessive alcohol consumption can damage the pancreas and liver and lead to obesity

o **Viral infections**: Some viral infections can destroy beta cells in people with certain immune systems

o **Malnutrition**: Malnutrition in early childhood can lead to partial beta cell dysfunction

o A **family history of** this disease increases the risk, and having both parents with diabetes significantly raises the likelihood of developing the disease

o **Environmental Factors:** The rise of this disease in India is strongly influenced by environmental factors. India is experiencing an **epidemiological transition, which involves changes in population distribution patterns, fertility rates, life expectancy, and leading causes of death.**

Key interventions to address rising burden of Diabetes

- Encouraging healthy lifestyles and stress reduction.
- Early Detection and Diagnosis**:** Promoting awareness and implementing screening programs.
- **Access to Quality Healthcare:** Improving healthcare infrastructure and ensuring equitable access.
- **Awareness:** Public health campaigns to raise awareness and encourage lifestyle modifications.
- **Policy Interventions:** Implementing policies for healthy environments and regulating unhealthy products.