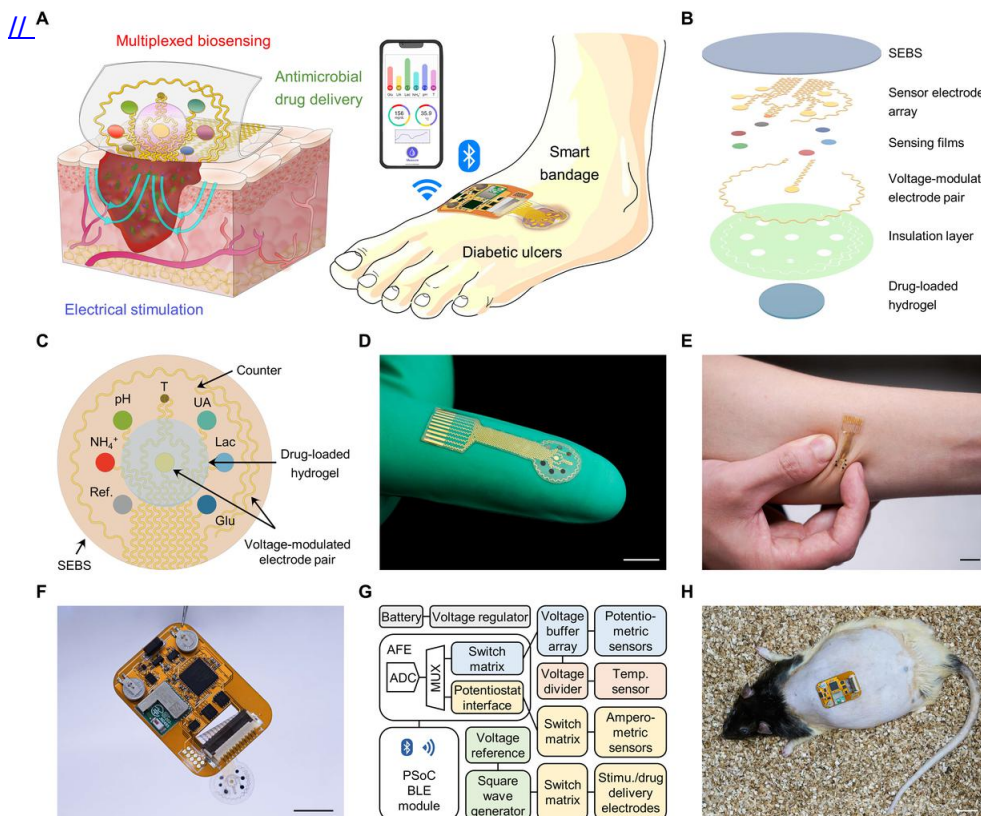




Smart Bandage

Why in News?

A recently published study highlights the development of a wearable, wireless, and mechanically flexible "smart bandage" that has the potential to **accelerate the healing of chronic wounds**.



What is a Smart Bandage?

▪ About:

- The smart bandage, developed by researchers at the **California Institute of Technology (Caltech)**, integrates **biosensors, drug-loaded hydrogels, electrical stimulation modules, and wireless communication**.
- It is designed to maintain contact with and adhere to the **skin using a soft, stretchable polymer**.
- The bandage includes biosensors that monitor wound biomarkers in the exudate, **providing real-time information about the wound's status**.
- Data collected by the bandage is **wirelessly transmitted to a smartphone** or tablet for review by healthcare professionals.

▪ Working Process:

- Biosensors track changes in the **chemical composition** of wound exudates, providing insights into the healing process.

- Additional sensors monitor **pH levels** and temperature, offering valuable information about **infection and inflammation**.
- The bandage includes **electrodes** that control drug release from a **hydrogel layer** and stimulate **tissue regeneration**.
- Wireless transmission of data eliminates the need for bulky equipment and wired connections, increasing convenience and usability.
- **Research Findings:**
 - Electrical stimulation **enhanced tissue regeneration** in skin cell studies.
 - Bandage accurately monitored infection, inflammation, and metabolic statuses in diabetic mice.
 - Diabetic rats treated with drugs and electrical stimulation **showed faster wound closure and reduced scarring**.
- **Limitations and Future Directions:**
 - **Biosensors had delayed response** due to chemical mixing.
 - Biosensor protection and manufacturing **scaling need improvement**.
- **Implications and Challenges:**
 - Chronic wounds burden healthcare systems, necessitating effective therapies.
 - Smart bandage offers continuous monitoring, targeted drug delivery, and reduced hospital visits.
 - **Affordability and accessibility challenges** for lower socio-economic individuals.
 - Government initiatives and insurance schemes can facilitate wider availability.

What are Chronic Wounds?

- Chronic wounds are wounds that **do not heal within the expected timeframe** and exhibit a disordered healing process.
- They are often associated with underlying health conditions such as **diabetes**, insufficient blood supply, nerve damage, or immune system dysfunction. Chronic wounds can include **diabetic ulcers**, pressure ulcers, venous ulcers, and non-healing surgical wounds.

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