ROHINI COLLEGE OF ENGINEERING AND TECHNOLOGY
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DEPARTMENT OF BIOMEDICAL ENGINEERING

VII Semester

OBT357 BIOTECHNOLOGY IN HEALTH CARE

UNIT- 4 OUT PATIENT & IN-PATIENT SERVICES

4.9. Cardiology

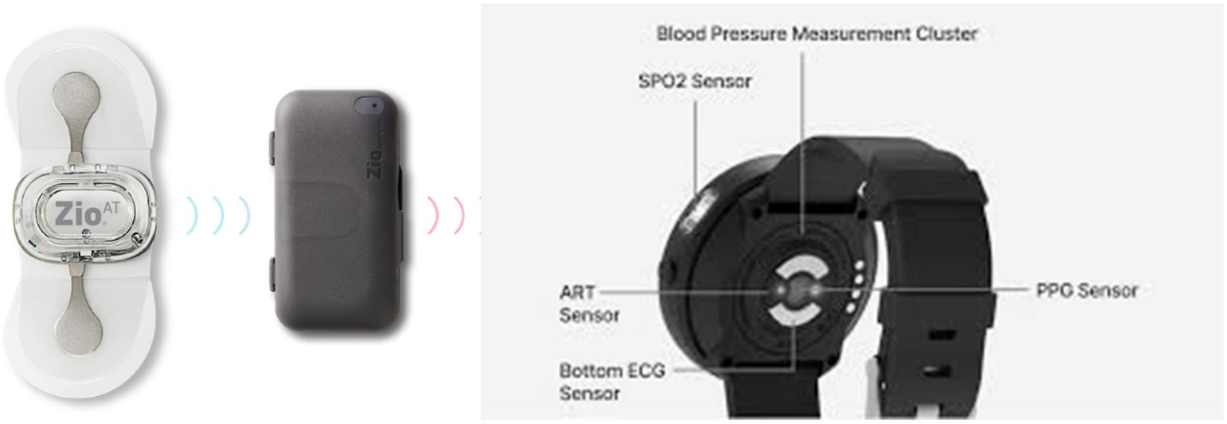
Cardiology, the branch of medicine dealing with disorders of the heart and circulatory system, has greatly benefited from biotechnology. Advancements in diagnostics, therapeutics, and monitoring have improved both outpatient and inpatient cardiac care, leading to better patient outcomes and reduced mortality rates.

I. Outpatient Cardiology Services

Outpatient cardiology focuses on non-invasive or minimally invasive care, typically for patients who don't require hospitalization. Biotechnology plays an important role in:

1. **Diagnostics**:

   - **Wearable Biosensors**: Devices like smartwatches and patches (e.g., Zio patch) use biotech to monitor heart rate, ECG, and arrhythmias in real-time, enabling remote patient monitoring and early detection of issues like atrial fibrillation.



- **Biomarker Assays**: Blood tests for biomarkers like troponin, BNP, or C-reactive protein, developed through biotech, help assess heart failure or cardiovascular risk without invasive procedures.

  - ✓ Measures the levels of heart muscle proteins in the blood to diagnose heart attacks or damage. Normally, these proteins stay within the heart cells, but when the heart muscle is damaged, they leak into the bloodstream, causing levels to rise. The troponin test is highly sensitive and specific for heart muscle damage, with results helping to determine the severity of a heart attack,

- **Genetic Screening**: Bio technology enables genetic tests (e.g., for familial hypercholesterolemia) to identify hereditary risks, guiding preventive care.

2. **Therapeutics**:

- **Personalized Medicine**: Pharmacogenomics tailors medications (e.g., antiplatelets like clopidogrel) based on genetic profiles to optimize efficacy and reduce side effects.
- **Biologics**: Monoclonal antibodies, such as PCSK9 inhibitors (e.g., evolocumab), lower LDL cholesterol for high-risk patients, administered in outpatient settings.
- **Telemedicine Platforms**: Biotech-integrated apps allow remote consultations, integrating data from wearables for real-time cardiologist feedback.

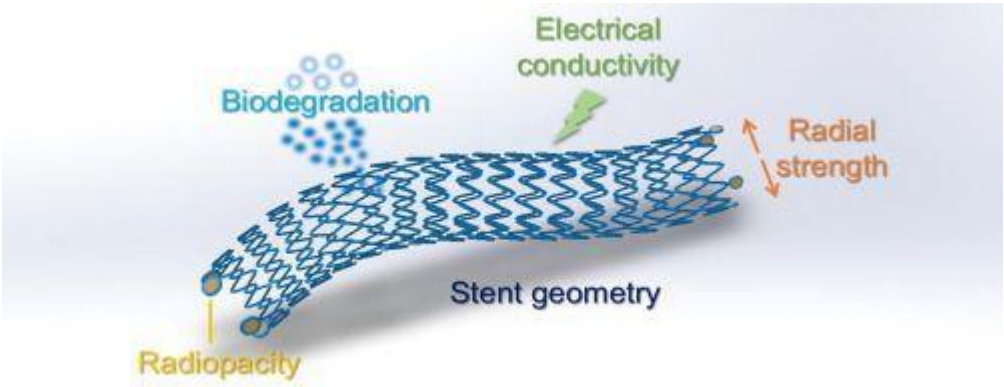
3. **Rehabilitation and Monitoring**:

- **Digital Therapeutics**: Apps and AI-driven platforms provide personalized cardiac rehab programs, tracking progress and adherence for patients post-event (e.g., myocardial infarction).
- **Implantable Monitors**: Devices like the Reveal LINQ monitor heart rhythms long-term, reducing the need for frequent clinic visits.

II. Inpatient Cardiology Services

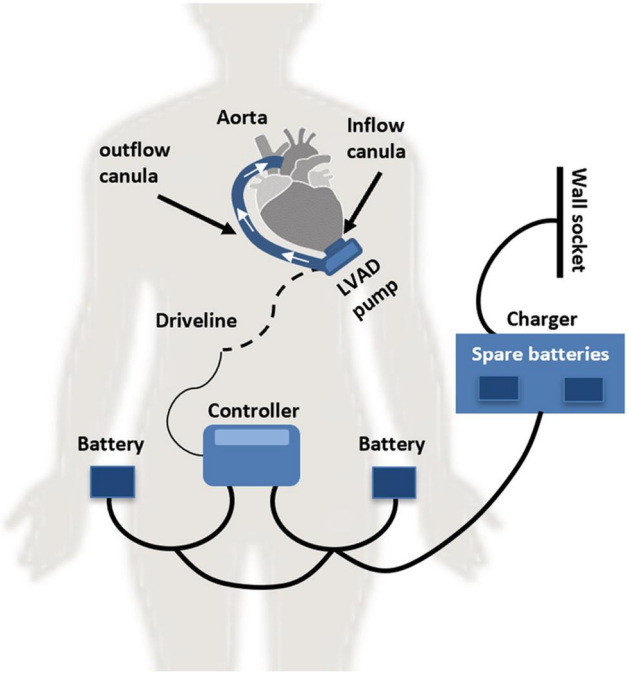
Inpatient cardiology involves acute or complex cases requiring hospitalization, such as heart attacks, heart failure, or surgical interventions. Biotechnology enhances:

1. **Diagnostics**:
    - **Advanced Imaging**: Biotech-driven tools like 3D echocardiography, cardiac MRI, and CT angiography use molecular imaging agents for precise visualization of heart structures and blockages.
    - **Point-of-Care Testing**: Rapid biomarker tests (e.g., high-sensitivity troponin) enable quick diagnosis of acute coronary syndrome in emergency settings.
2. **Interventional Cardiology**:
    - **Bioengineered Stents**: Drug-eluting stents coated with biocompatible polymers (e.g., everolimus) reduce restenosis rates in angioplasty patients.

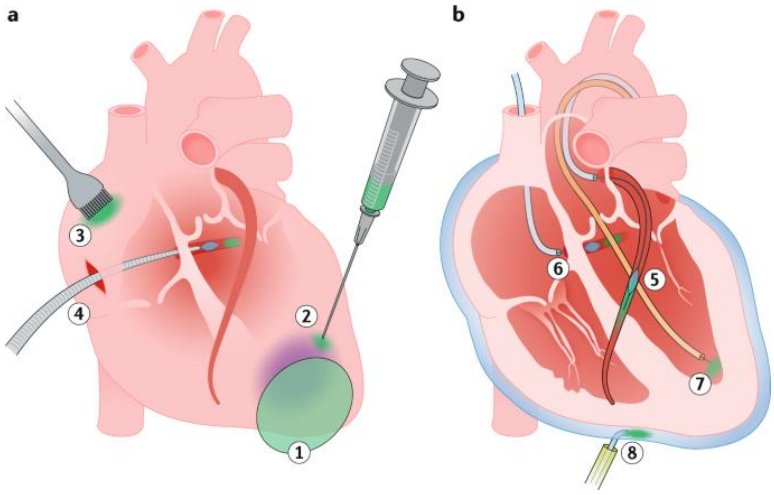


    - **Transcatheter Therapies**: Biotech innovations like transcatheter aortic valve replacement (TAVR) use biocompatible valves, offering less invasive options for high-risk patients.
    - **Gene and Cell Therapies**: Emerging therapies, such as stem cell treatments for myocardial regeneration or gene-editing (e.g., CRISPR for hypertrophic cardiomyopathy), are being trialed to repair damaged heart tissue.

3. **Critical Care**:
    - **Biomedical Devices**: Ventricular assist devices (VADs) and artificial hearts incorporate biotech materials for durability and compatibility, supporting patients with end-stage heart failure.

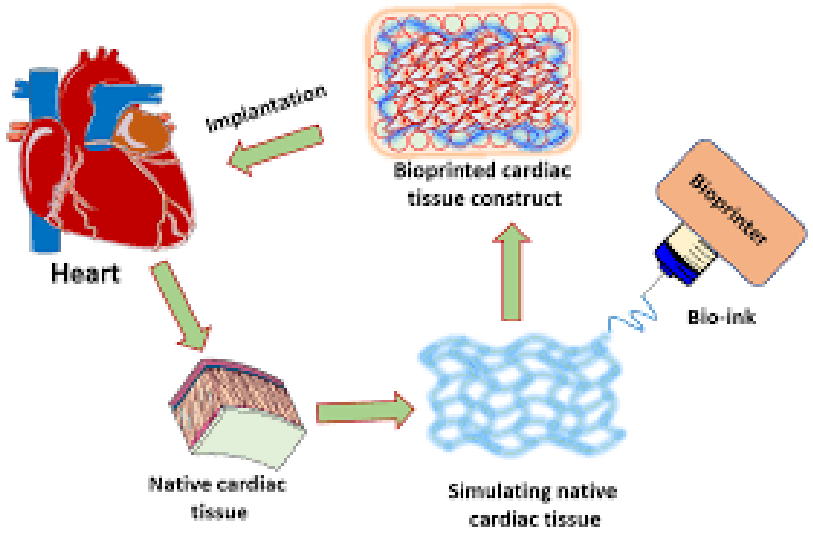


    - **Targeted Drug Delivery**: Nanoparticle-based systems deliver drugs directly to affected cardiac tissue, minimizing systemic side effects in acute settings.

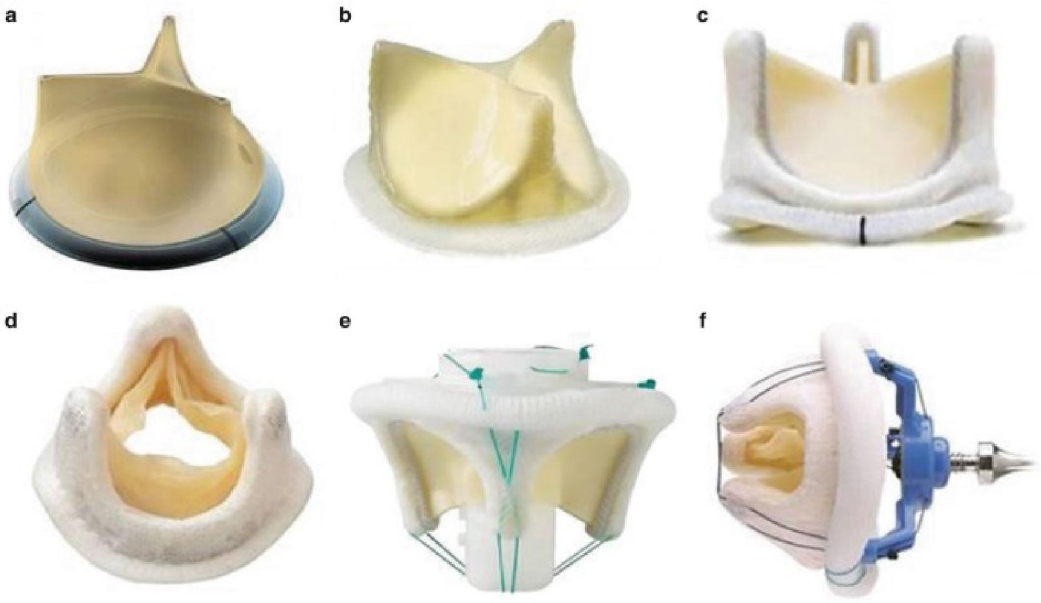


- ❖ **Pericardial space** – shown with fluid collection (possibly pericardial effusion).
- ❖ **Needle injection** – indicates pericardiocentesis (aspiration of fluid from the pericardial sac).
- ❖ **Epicardial approach** – access through the chest wall for catheter/electrode placement.
- ❖ **Catheter insertion** – transvenous route into the heart chambers.

4. **Surgical Support**:
   - **Tissue Engineering**: Bioprinted heart tissue or patches are under development to repair damaged myocardium during open-heart surgeries.



   - **Robotics and AI**: Biotech-integrated robotic systems assist in precision surgeries like coronary artery bypass grafting (CABG), improving outcomes.
   - **Biologically-Engineered Implants:** From **bioprosthetic valves** made from animal tissue to genetically engineered stents, biotechnology is creating more compatible and durable medical implants. These advanced materials reduce the body's rejection response and improve long-term outcomes for patients undergoing cardiac surgery.

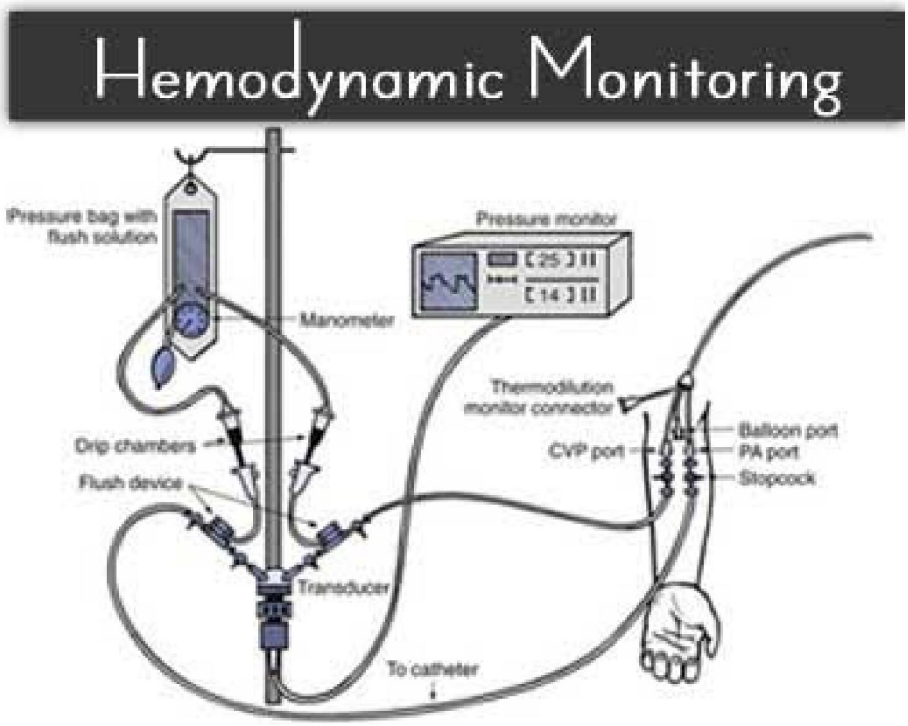


4. Critical Care & Monitoring

i. **Continuous hemodynamic monitoring systems**.

ii. **Extracorporeal Membrane Oxygenation (ECMO)** for severe cardiac failure.

iii. **Artificial intelligence integration** for predicting arrhythmias and cardiac arrest.



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