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

4.6. Gastroenterology

- Gastroenterology is the medical field dedicated to the study and treatment of the digestive system and its disorders, including the esophagus, stomach, intestines, liver, pancreas, and gallbladder.
- Biotechnology has revolutionized healthcare by providing advanced tools for diagnosis, treatment, and prevention of gastrointestinal (GI) disorders. In gastroenterology, biotechnology integrates molecular biology, genetics, microbiome research, and therapeutic engineering to improve patient care.

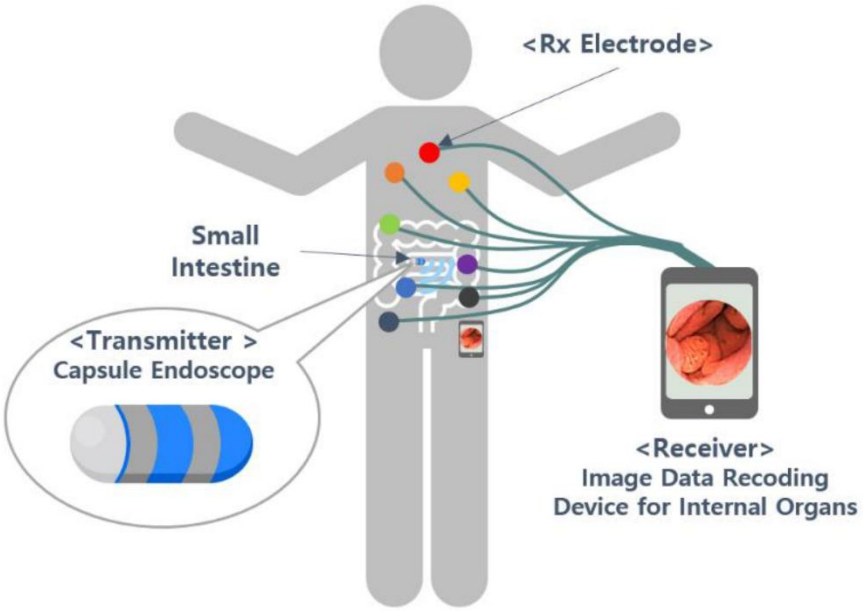
4.6.1 Applications of Biotechnology in Gastroenterology:

A. Diagnostic Applications:

- **Molecular diagnostics**: Molecular diagnostics in gastroenterology involves the use of biotechnology to analyze biological markers—such as DNA, RNA, proteins, or metabolites—at the molecular level to detect, diagnose, and monitor gastrointestinal (GI) diseases. These techniques enable early detection, precise characterization, and personalized treatment strategies for conditions like colorectal cancer, inflammatory bowel disease (IBD), irritable bowel syndrome (IBS), and liver diseases

- **Non-invasive tests**: Non-invasive molecular diagnostic tests in gastroenterology use advanced biotechnology to detect and monitor gastrointestinal (GI) diseases without the need for invasive procedures like endoscopy or biopsy. These tests analyze biological samples—such as blood, stool, urine, or breath—for molecular markers (DNA, RNA, proteins, or metabolites) to diagnose conditions like colorectal cancer.

- **Endoscopic innovation**: Capsule endoscopy with biosensors to detect bleeding, infection, or inflammation. These advancements integrate advanced imaging, robotics, artificial intelligence (AI), biomaterials, and molecular tools to improve precision, reduce complications, and enhance patient outcomes for conditions like colorectal cancer, inflammatory bowel disease (IBD), esophageal disorders, and liver diseases.



- **Proteomics and metabolomics**: Proteomics and metabolomics are advanced molecular diagnostic approaches that analyze proteins and metabolites, respectively, to provide insights into the mechanisms, diagnosis, and management of gastrointestinal (GI) diseases.

B. Therapeutic Applications:

- **Biologics**: Monoclonal antibodies (e.g., infliximab, adalimumab) targeting TNF-α for inflammatory bowel disease (IBD). Monoclonal antibodies (mAbs) are laboratory-made proteins that mimic the body's immune response to target specific antigens, such as those found on cancer cells or viruses.
- **Microbiome therapy**:
  - **Probiotics and engineered microbes** for restoring gut microbiota balance.
  - **Fecal microbiota transplantation (FMT)** Fecal microbiota transplantation (FMT) is a medical procedure that involves transferring

stool from a healthy donor into the gastrointestinal tract of a recipient. The goal is to restore the balance of beneficial bacteria and other microorganisms (the gut microbiota) in the recipient's gut.

- **Gene therapy**: Gene therapy is a medical field that involves using genetic material to treat or prevent disease. The core principle is to either replace a faulty or missing gene with a healthy one, deactivate a problematic gene, or introduce a new gene into the body to help fight a disease for hereditary GI disorders (e.g., cystic fibrosis affecting pancreas, polyposis syndromes).

- **RNA-based therapies**: siRNA and mRNA strategies for targeting GI inflammation or fibrosis.

- **siRNA (small interfering RNA)** therapy for GI inflammation focuses on "silencing" or turning off specific genes that contribute to the inflammatory process.
- **mRNA (messenger RNA)** therapy for GI inflammation takes the opposite approach: it instructs cells to produce a beneficial, therapeutic protein.

4.6.2. Outpatient Services in Gastroenterology with Biotechnology

These are services where patients do not require admission. Biotechnology helps in **early detection, monitoring, and minimally invasive care**.

- **Diagnostic Services**
  - Non-invasive molecular tests (e.g., stool DNA test for colorectal cancer, *Helicobacter pylori* breath test).
  - Liquid biopsy (circulating tumor DNA) for GI cancers.
  - Microbiome analysis for IBS and IBD.
- **Endoscopic Innovations**
  - Capsule endoscopy with biosensors.
  - AI-assisted endoscopy for polyp/cancer detection.
- **Therapeutics in Outpatient Care**
  - Biologics and biosimilars for IBD (administered in clinics).
  - Probiotics and engineered microbial therapies for gut health.

  - Vaccinations (Hepatitis B, Rotavirus).
- **Monitoring & Personalized Medicine**
  - Genetic testing for hereditary GI syndromes (FAP, Lynch syndrome).
  - Pharmacogenomic testing (drug response prediction).
  - Wearable biosensors to track gut motility and pH.

3. Inpatient Services in Gastroenterology with Biotechnology

These are services where hospital admission is required for complex or advanced treatments. Biotechnology supports **precision therapies, critical care, and surgical interventions**.

- **Advanced Diagnostics**
  - Endoscopic ultrasound with molecular imaging.
  - Biopsy with genomic & proteomic profiling for GI cancers.
- **Therapeutic Services**
  - Administration of monoclonal antibodies (infliximab, adalimumab) under supervision.
  - Fecal microbiota transplantation (FMT) for recurrent *C. difficile* infection.
  - Gene therapy (experimental) for hereditary GI disorders.
  - Stem cell therapy for severe IBD (Crohn's).
- **Surgical & Critical Care**
  - Biotechnology-assisted minimally invasive surgery (robotic-assisted GI surgery).
  - 3D-printed biocompatible scaffolds for GI tissue repair.
- **Research & Clinical Trials**
  - Use of patient-derived intestinal organoids for drug testing.
  - Nanotechnology-based targeted drug delivery in hospitalized patients.