Metformin is one of the most widely prescribed oral antihyperglycemic agents.
Its primary mechanism of action involves the activation of **AMP-activated protein kinase (AMPK)**, a central metabolic regulator that promotes glucose uptake and fatty acid oxidation while inhibiting hepatic gluconeogenesis.
Beyond its glycemic control, Metformin has been shown to improve cardiovascular outcomes and display anti-inflammatory properties.
Recent studies also suggest potential anticancer effects through inhibition of the mTOR signaling pathway and suppression of tumor angiogenesis.

Clinical trials have demonstrated that combining **Atorvastatin** with **Ezetimibe** results in significant reductions in low-density lipoprotein cholesterol (LDL-C) levels compared to monotherapy.
Ezetimibe acts by inhibiting the Niemann–Pick C1-like 1 (NPC1L1) transporter in the intestinal wall, reducing cholesterol absorption, while Atorvastatin inhibits hepatic HMG-CoA reductase, suppressing endogenous cholesterol synthesis.
The dual mechanism provides an additive lipid-lowering effect, particularly beneficial for patients with familial hypercholesterolemia who are unresponsive to statins alone.

The success of mRNA vaccines against SARS-CoV-2 has opened new pathways for rapid vaccine development.
mRNA platforms enable flexible design and quick adaptation to emerging viral variants such as **BQ.1** and **XBB.1.5**.
Phase-II clinical trials have shown strong immunogenicity with elevated neutralizing antibody titers and robust $CD8^+$ T-cell responses.
Ongoing research is exploring thermostable formulations and self-amplifying mRNA constructs to enhance global distribution and cost-efficiency.

Artificial intelligence (AI) is transforming pharmaceutical research by accelerating target identification, molecular docking, and compound screening.
Deep learning models trained on large-scale biological datasets can predict protein–ligand binding affinities and optimize lead compounds.
Integrating AI-driven insights with laboratory automation is reducing discovery timelines from years to months.
However, challenges remain regarding interpretability, bias mitigation, and regulatory validation for AI-generated molecules.