

Pharmacogenomics in Cardiovascular disease

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Introduction: Pharmacogenomics integrates genetics and pharmacology to individualize drug therapy, ensuring the **right drug at the right dose for each patient**. In cardiovascular diseases, genetic markers help predict drug response, metabolism, and toxicity. Studies indicate that pharmacogenomics is clinically significant for about 72% of cardiovascular medications, underscoring its essential role in cardiac care.

Pharmacogenomics guidance for key cardiac drugs

Genetic testing for specific genes helps clinicians tailor drug selection and dosage for critical cardiovascular medications:

Drug class	Example	Key genes	Impact of variation	Guidance for Personalized treatment
Anticoagulants (Strong evidence)	Warfarin	CYP2C9, VKORC1	Variations affect drug metabolism & sensitivity	Dose adjustment to avoid bleeding/subtherapeutic effect.
Anti-platelet Agents (Strong evidence)	Clopidogrel	CYP2C19	poor metabolizers - fail to activate	Prasugrel or Ticagrelor in poor metabolizers.
Lipid-Lowering (Moderate)	Statins	SLCO1B1	Increased risk of myopathy	Dose/choice adjustment to avoid myopathy
Blood pressure (Limited evidence)	ACE Inhibitors	ADTR1	Variants affect response and outcomes	Helps identify patients with poor response to ACE inhibitor therapy.
Rhythm control (Minimal evidence)	Beta-Blockers	CYP2D6	Alters metabolism & receptor response	Adjust to improve heart rate control & reduce adverse effects

Impact on recent times & future trends

Genotype-guided therapy has moved from research into mainstream cardiology practice. Integration with clinical decision-support tools enables personalized prescribing, especially for anticoagulants, antiplatelet agents, and statins. Rapid genotyping, next-generation sequencing, and multi-omics analysis now facilitate faster and more accurate testing. Emerging tools include:

- CRISPR-based editing for correcting pathological gene variants.
- AI-driven analytics for interpreting complex genetic data in real time.
- Wearable biosensors that monitor therapy response dynamically.

These innovations collectively enhance individualized cardiovascular care and therapeutic precision.