Biomarkers Journal
ISSN: 2472-1646

Open access Opinion

Genomic Biomarkers: Bridging the Gap between Genetics and Precision Medicine

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INTRODUCTION

Genomic biomarkers are DNA or RNA characteristics that provide information about biological processes, disease predisposition, or response to therapeutic interventions. These markers are revolutionizing the landscape of modern medicine by enabling personalized approaches to diagnosis, treatment, and drug development. Genomic biomarkers are specific genetic variations, such as Single Nucleotide Polymorphisms (SNPs), copy number variations, gene expression levels, or epigenetic modifications, that are associated with particular physiological or pathological states. These markers serve as indicators of genetic predisposition, disease presence, progression, or response to treatment. Associated with hereditary breast and ovarian cancer risk. Predictive of responsiveness to tyrosine kinase inhibitors in Non-Small Cell Lung Cancer (NSCLC). Indicative of resistance to certain targeted therapies in colorectal cancer. Genomic biomarkers help identify molecular targets for drug development by revealing genetic drivers of disease. For instance, the discovery of BCR ABL fusion in Chronic Myeloid Leukaemia (CML) led to the development of imagine, a targeted therapy. They enable the selection of patient subgroups based on genetic profiles, optimizing clinical trial design and ensuring higher success rates. HER2 amplification in breast cancer is used to identify patients for trastuzumab therapy. Genomic biomarkers predict individual responses to specific treatments. For example, testing for HLA-B-5701 can identify individuals at risk of hypersensitivity to batcaver, an antiretroviral drug.

DESCRIPTION

These biomarkers measure biological responses to a drug, helping to determine the optimal dose and therapeutic effect. For example, changes in PD-1/PD-L1 expression guide immunotherapy. Genomic markers like TPMT polymorphisms predict susceptibility to adverse drug reactions, such as myelosuppression in patients treated with thiopurines. Enable tailored therapies that improve efficacy and minimize side effects by aligning treatments with patients' genetic profiles. Facilitate efficient drug discovery and testing by identifying appropriate targets and populations. Provide accurate forecasts of disease progression and therapeutic outcomes. By improving success rates in clinical trials, genomic biomarkers reduce the overall costs of drug development. The vast genetic variability across populations complicates biomarker discovery and validation. Genomic data usage raises issues about data security and potential discrimination based on genetic information. Advanced technologies for genomic biomarker identification and testing remain expensive, limiting accessibility.

CONCLUSION

Offer a minimally invasive method for monitoring genomic biomarkers in circulating tumour DNA (ctDNA). The integration of genomic biomarkers into drug development is advancing rapidly. Combining genomic data with proteomics and metabolomics for a more comprehensive understanding of disease. Utilizing wearable devices and biosensors to track dynamic changes in genomic biomarkers. Standardizing biomarker research through international partnerships to ensure equitable access to genomic medicine. Using genomic biomarkers to predict disease risk and guide preventive strategies. Genomic biomarkers are at the forefront of precision medicine, offering unprecedented opportunities to revolutionize drug development and patient care.

ACKNOWLEDGEMENT

None.

CONFLICT OF INTEREST

The author's declared that they have no conflict of interest.

Received:	02-December-2024	**Manuscript No:**	IPBM-25-22306
Editor assigned:	04-December-2024	**PreQC No:**	IPBM-25-22306 (PQ)
Reviewed:	18-December-2024	**QC No:**	IPBM-25-22306
Revised:	23-December-2024	**Manuscript No:**	IPBM-25-22306 (R)
Published:	30-December-2024	**DOI:**	10.36648/2472-1646.10.6.54

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Citation Daniel H (2024) Genomic Biomarkers: Bridging the Gap between Genetics and Precision Medicine. Biomark J. 10:54.