ICSRR – S014

PRECISION ONCOLOGY AND PERSONALIZED MEDICINE

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Abstract:

Precision oncology and personalized medicine mark a transformative shift in modern cancer therapy. Unlike traditional approaches that rely on generalized strategies, precision oncology accounts for tumor heterogeneity and genetic variability to optimize treatment outcomes. By integrating genomic profiling, biomarker discovery, and advanced computational methods, clinicians can tailor therapies to individual patients. Technologies such as next-generation sequencing, liquid biopsy, and multi-omics analysis enable identification of molecular drivers of tumor development and progression. Targeted therapies (e.g., EGFR inhibitors) and immunotherapies (e.g., PD-1 checkpoint blockade) have improved efficacy and reduced toxicity compared with conventional chemotherapy. Artificial intelligence and machine learning further enhance clinical decision-making by deciphering complex genomic datasets. Despite these advances, clinical, economic, and computational barriers—including tumor heterogeneity, high costs of testing, and challenges in data interpretation—limit widespread adoption. Continued research, integration of emerging technologies, and expansion of biomarker-driven clinical trials will strengthen the role of precision oncology, ultimately advancing more effective, less toxic, and patient-centered cancer care.

Keywords: Precision oncology, personalized medicine, genomic profiling, biomarkers, next-generation sequencing.

ISBN 978-819992069-9