



Genomic Profiling for Precision Oncology: Unlocking Targeted Treatments

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DESCRIPTION

Cancer has long been considered a complex and heterogeneous disease, with treatments historically relying on a one-size-fits-all approach. However, in recent years, the field of oncology has witnessed a transformative shift towards precision medicine, driven by advancements in genomic profiling. Genomic profiling enables healthcare providers to focus deep into a patient's genetic makeup, uncovering the unique genetic alterations driving their cancer. This knowledge allows for the development of targeted therapies tailored to the individual, marking a paradigm shift in cancer treatment.

Genomic profiling involves the comprehensive analysis of a patient's genetic material, including the DNA, RNA, and proteins within their cancer cells. This detailed examination identifies the specific genetic mutations and alterations responsible for fueling the growth and spread of the cancer. These are genetic alterations that directly contribute to the development and progression of cancer. Identifying driver mutations is essential for designing targeted treatments.

Some cancers can be categorized into different molecular subtypes based on their genetic characteristics. Each subtype may respond differently to treatment, necessitating personalised approaches. Genomic profiling can predict a cancer's sensitivity or resistance to specific drugs, enabling the selection of the most effective treatment options. Genetic information can provide insights into a patient's prognosis, helping to guide treatment decisions and expectations.

A sample of the tumor tissue is obtained, typically through a biopsy or surgery. The DNA from the tumor tissue is isolated and purified. Advanced technologies, such as Next-Generation Sequencing (NGS), are employed to read and analyze the DNA's sequence, identifying mutations and alterations. Bioinformatics tools and expertise are used to interpret the sequencing data, identifying relevant genetic changes. A detailed report is generated, summarizing the genetic findings and their implications for treatment.

Genomic profiling plays a pivotal role in the development of targeted therapies, which are drugs designed to specifically target the genetic mutations driving a patient's cancer. Targeted therapies are highly effective because they directly interfere with the cancer's underlying genetic mechanisms. This often results in better treatment responses and outcomes. Targeted therapies are generally more selective in their action, sparing healthy cells from damage and reducing the severity of side effects compared to traditional chemotherapy.

Targeted therapies are personalised to an individual's unique genetic makeup, making them a prime example of precision medicine. Genomic profiling can help identify potential mechanisms of drug resistance, allowing for the development of combination therapies to overcome resistance.

Genomic profiling identified the *HER2* gene amplification in certain breast cancers. Targeted therapies like Herceptin have dramatically improved the prognosis for patients with *HER2*-positive breast cancer.

Genomic profiling has revealed *EGFR* mutations in a subset of lung cancer patients. Targeted drugs like Erlotinib and Osimertinib have shown remarkable effectiveness in these cases. *BRAF* mutations are common in melanoma. Drugs like Vemurafenib and Dabrafenib, which specifically target these mutations, have significantly improved survival rates.

Genomic profiling can be expensive, limiting its accessibility for some patients. Efforts are ongoing to reduce costs and increase availability. Cancers are often genetically heterogeneous, meaning they contain multiple subpopulations of cells with different genetic profiles. Profiling one region may not capture the entire genetic landscape. Some cancers develop resistance to targeted therapies over time. Continuous monitoring and research are needed to overcome this challenge. Genomic data must be handled with care to ensure patient privacy and prevent misuse.

Genomic profiling is at the forefront of the precision medicine revolution in oncology, provide aspiration to cancer patients by

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personalised treatments to their unique genetic makeup. The ability to identify driver mutations, molecular subtypes, and drug sensitivities allows oncologists to select the most effective therapies while minimizing side effects. As research continues

and technology evolves, genomic profiling will undoubtedly play an increasingly vital role in transforming cancer care and improving outcomes for patients worldwide.