[A History of Cancer Research: 7 Crucial Breakthroughs](http://www.conversantbio.com/blog/a-history-of-cancer-research-7-crucial-breakthroughs)

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The advancements in cancer drug discovery have really exploded in the last decade, but there have been specific crucial  scientific breakthroughs that have changed the course of targeted cancer therapy and personalized medicine. The field of oncology is burgeoning and current research is addressing specific “tumors” instead of specific “cancers.” For instance, breast cancer is not just one type of cancer. There are 6 known types of breast cancers. The discovery of genetic mutations and biological influences of various tumors, sets the stage for a new field of clinical research in the area of targeted cancer therapy. This paradigm shift is due largely to the following discoveries:

1. **Mutationally Activated RAS Genes** - In 1982, [discovery of mutationally activated RAS](http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3109476/)genes in human cancer that stimulated an intensive research effort to understand Ras protein structure, biochemistry and biology. While the ultimate goal has been developing anti-Ras drugs for cancer treatment, discoveries from Ras have laid the foundation for three broad areas of science. In light of the current lack of success in developing clinically useful anti-Ras drugs, recent studies have taken advantage of [KRAS oncogene](http://www.ncbi.nlm.nih.gov/pubmed/19490893)to search for synthetic lethal partners of mutant KRAS. Utilizing RNA interference (RNAi) technologies, large-scale interfering RNA screens have been applied to take a functional and unbiased approach to identify therapeutic targets for anti-Ras inhibition.
2. **Genetic Defects** - Discovery of genetic defects in patients with Chronic Myelogenous Leukemia (CML), noting the Abelson Virus as the “culprit” in molecular defects and making the disease more progressive. This discovery ultimately led researchers to discover the drug that fit like “hand in glove,” Gleevec, a tyrosine-kinase inhibitor used in the treatment of multiple cancers, most notably [Philadelphia chromosome](http://en.wikipedia.org/wiki/Philadelphia_chromosome)-positive (Ph+) [chronic myelogenous leukemia](http://en.wikipedia.org/wiki/Chronic_myelogenous_leukemia) (CML).(2)
3. **Breakpoint of Cluster Region Protein (BCR)** - The breakpoint cluster region protein (BCR) also known as renal carcinoma antigen NY-REN-26 is a [protein](http://en.wikipedia.org/wiki/Protein) that in humans is encoded by the BCR [gene](http://en.wikipedia.org/wiki/Gene). BCR is one of the two genes in the BCR-ABL complex, which is associated with the [Philadelphia chromosome](http://en.wikipedia.org/wiki/Philadelphia_chromosome). Two transcript variants encoding different isoforms have been found for this gene.
4. **Inhibitors to Resistant Proteins** - Backup inhibitors to resistant proteins are discovered, and new drugs, likeSelective inhibition of protein tyrosine kinases is gaining importance as an effective therapeutic approach for the treatment of a wide range of human cancers. However, as extensively documented for the BCR–ABLoncogene in imatinib-treated leukaemia patients, clinical resistance caused by mutations in the targeted oncogene has been observed.
5. **HER Receptors**- The HER receptors are proteins that are embedded in the cell membrane and communicate molecular signals from outside the cell (molecules called [EGFs](http://en.wikipedia.org/wiki/Epidermal_growth_factor)) to inside the cell, and turn genes on and off. The HER proteins stimulate cell proliferation. In some cancers, notably certain types of breast cancer, HER2 is over-expressed, and causes cancer cells to reproduce uncontrollably. [Trastuzumab](http://www.ncbi.nlm.nih.gov/pubmed/23393341) ([INN](http://en.wikipedia.org/wiki/International_Nonproprietary_Name); trade namesHerclon, Herceptin) is a [monoclonal antibody](http://en.wikipedia.org/wiki/Monoclonal_antibody) that interferes with the[HER2/neu](http://en.wikipedia.org/wiki/HER2/neu) [receptor](http://en.wikipedia.org/wiki/Receptor_(biochemistry)). Its main use is to treat certain [breast cancers](http://en.wikipedia.org/wiki/Breast_cancer).
6. **Epidermal Growth Factor Receptor (EGFR)** - Activating mutations within the [epidermal growth factor receptor](http://www.ncbi.nlm.nih.gov/pubmed/25383627) (EGFR) kinase domain, commonly L858R or deletions within exon 19, increase EGFR-driven cell proliferation and survival and are correlated with impressive responses to the EGFR inhibitors erlotinib and gefitinib in non-small cell lung cancer patients.
7. **Kinase Inhibitor (TK)** - The tyrosine kinase (TK) inhibitor, Imatinib, has revolutionized the therapy of malignancies that are addicted to one of its target kinases, and is currently the standard of care in CML (chronic myeloid leukemia) as it has dramatically changed the outlook of these disease. Its use has extended to various other cancers and has achieved first-line position in cancers like Ph+(Philadelphia Chromosome) ALL(adult lymphocytic leukemia).

No other targeted therapies have contributed so much to therapeutic armamentarium in oncology as Imatinib. Various studies are ongoing to explore its benefits in other cancers also. The major drawback with Imatinib is development of resistance which is therapeutically challenging. Second- and third-generation TKIs have come up to overcome this resistance. Despite these limitations, Imatinib has contributed immensely to the field of oncology so that it should still be called a “wonder drug.”

Clearly, we are on the brink of new and amazing discoveries in the area of cancer treatment, particularly with targeted drugs and personalized medicine to treat the very specific tumor type that a patient uniquely possesses. Tissue and blood research continue to yield vital informations to help scientists develop the best targeted therapies.