

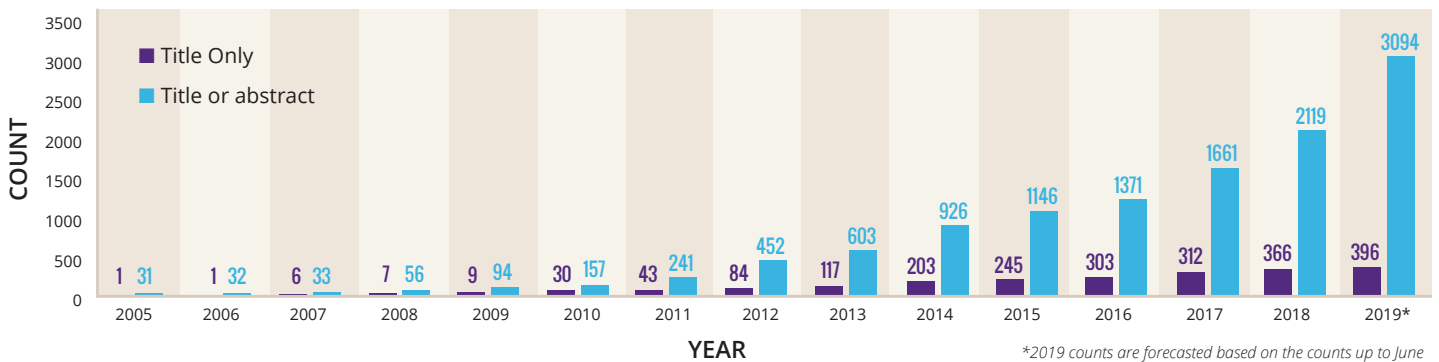
# By the Numbers: Personalized Medicine Based on Whole Genome Sequencing

Section Editor: The ISPOR Student Network

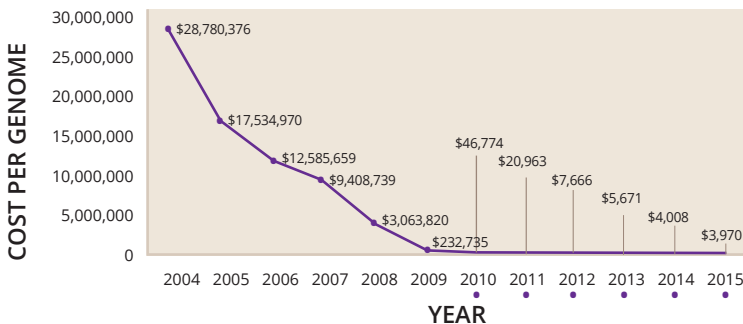
## Milestones in Personalized Medicine

- 1869** The discovery of DNA by the Swiss chemist Friedrich Miescher sets the stage for future studies in molecular medicine<sup>1</sup>
- 1953** Double helix structure of DNA proposed by James D. Watson and Francis H.C. Crick<sup>2</sup>
- 1977** First DNA sequencing method developed by Frederick Sanger<sup>3</sup>
- 1990** Work begins on the Human Genome Project, a 13-year project coordinated by the U.S. Department of Energy and the National Institutes of Health<sup>4</sup>
- 1998** FDA approves Herceptin, a pioneer drug in personalized medicine for the treatment of HER2-positive metastatic breast cancer<sup>5</sup>
- 2012** Icelandic company DeCODE Genetics, which proposed the world's first population-wide genetic biobank in the late 1990s is acquired by Amgen for \$415 million<sup>6</sup>
- 2015** Former United States President Barack Obama signs and launches the bipartisan \$215 million 'Precision Medicine Initiative'<sup>7</sup>

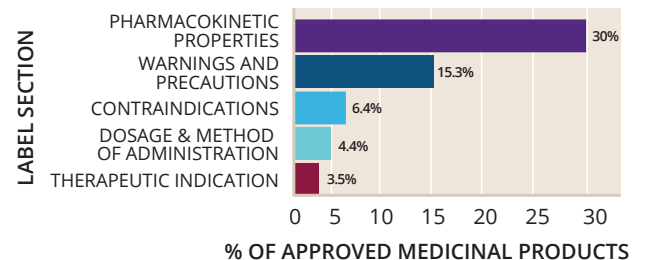
## Number of PubMed Publications with the Term "Whole Genome Sequencing" in their Title and/or Abstract (2005 – 2019)



## Costs for Whole Genome Sequencing (2004-2015)<sup>8</sup>



## % of European Medicines Agency (EMA) authorized medicinal products with any pharmacogenomic information in their labels by product characteristics: 1995-2014



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References: <sup>1</sup>Dahm, R., 2005. Friedrich Miescher and the discovery of DNA. *Developmental biology*, 278(2), pp.274-288.; <sup>2</sup>Watson, J.D. and Crick, F.H., 1953. Molecular structure of nucleic acids. *Nature*, 171(4356), pp.737-738.; <sup>3</sup>Sanger, F., Nicklen, S. and Coulson, A.R., 1977. DNA sequencing with chain-terminating inhibitors. *Proceedings of the national academy of sciences*, 74(12), pp.5463-5467.; <sup>4</sup>Roberts, L., 2001. Timeline: A History of the Human Genome Project. *Science*, 291(5507), pp.1195-1200.; <sup>5</sup>FDA Advisory Committee Recommends Approval of First Monoclonal Antibody for Metastatic Breast Cancer. Genentech Press Release: <https://www.gene.com/media-press-releases/4774/1998-09-02/fda-advisory-committee-recommends-approv>. Accessed: 06/12/2019; <sup>6</sup>Amgen to Buy DeCODE Genetics for \$415 Million. *The Wall Street Journal*. <https://www.wsj.com/articles/SB1000142412788732-4478304578171061990840422>. Accessed: 06/12/2019; <sup>7</sup>Terry, S.F., 2015. Obama's precision medicine initiative. *Genetic testing and molecular biomarkers*, 19(3), pp.113-114.; <sup>8</sup>Wetterstrand KA. DNA Sequencing Costs: Data from the NHGRI Genome Sequencing Program (GSP) Available at: [www.genome.gov/sequencingcostsdata](http://www.genome.gov/sequencingcostsdata). Accessed May 28 2019; <sup>9</sup>Ehmann, F., Caneva, L., Prasad, K., Paulmichl, M., Maliepaard, M., Llerena, A., Ingelman-Sundberg, M. and Papaluca-Amati, M., 2015. Pharmacogenomic information in drug labels: European Medicines Agency perspective. *The pharmacogenomics journal*, 15(3), p.201.