

Implementation

Full realization of the potential of personalized medicine requires further investment and collaboration [6]:

01

Recognizing the **urgency** and **necessity** of personalized medicine and **molecular identification**

Digitizing healthcare and developing **single-cell omics** to investigate cells

02

03

Imbue **skills** and **principles** of into **existing healthcare systems** to exploit **scientific advancement** to better patient care

Using **biomarkers** to further **research and development** and small size trials

04

05

Forming professional **partnerships** between different **diagnostic** and **development** corporations and industries

Educating sales teams with patient **history**, diagnostic **treatment** methods, and **disease pathways**

06

07

Post market surveillance to better **focus** future **clinical trials** of pharmaceutical products



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*"The **primary goal** and **benefit** of patient-centered care is to **improve individual health outcomes**, not just population health outcomes" [8]*

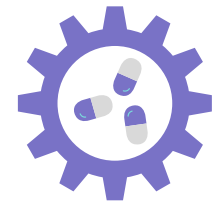


References

- [1] A. E. Hammerstrom, D. H. Cauley, B. J. Atkinson, and P. Sharma, "Cancer Immunotherapy: Sipuleucel-T and Beyond," *Pharmacotherapy*, vol. 31, no. 8, pp. 813–828, Aug. 2011, doi: 10.1592/phco.31.8.813.
- [2] S. Reardon, "First CRISPR clinical trial gets green light from US panel," *Nature*, Jun. 22, 2016, <https://www.nature.com/articles/nature.2016.20137>.
- [3] "Frontiers | Milestones in Personalized Medicine: From the Ancient Time to Nowadays—the Provocation of COVID-19 | Genetics." <https://www.frontiersin.org/articles/10.3389/fgene.2020.569175/full>
- [4] F. R. Wilson et al., "Herceptin® (trastuzumab) in HER2-positive early breast cancer: a systematic review and cumulative network meta-analysis," *Syst Rev*, vol. 7, no. 1, Art. no. 1, Dec. 2018, doi: 10.1186/s13643-018-0854-y.
- [5] F. R. Vogenberg, C. Isaacson Barash, and M. Pursel, "Personalized Medicine," *P T*, vol. 35, no. 10, pp. 560–576, Oct. 2010.
- [6] S. Mathur and J. Sutton, "Personalized medicine could transform healthcare," *Biomed Rep*, vol. 7, no. 1, pp. 3–5, Jul. 2017, doi: 10.3892/br.2017.922.
- [7] W. Sadée and Z. Dai, "Pharmacogenetics/genomics and personalized medicine," *Human Molecular Genetics*, vol. 14, no. suppl_2, pp. R207–R214, Oct. 2005, doi: 10.1093/hmg/ddi261.
- [8] N. Catalyst, "What Is Patient-Centered Care?," *NEJM Catalyst*, Jan. 2017. [Online]. Available: <https://catalyst.nejm.org/doi/full/10.1056/CAT.17.0559>

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PERSONALIZED MEDICINE

Individualized Care
Pharmacogenetics

NAE Grand Challenge 5:
Engineering Better Medicines

1

Importance

The **potential** for personalized medicine to **tailor therapy** with the **best response** and **highest margin of safety** to better **individual** patient care and **outcomes** is significant. [6,7]



Using **pharmacogenetic/genomic analysis** techniques to divide patients into **groups** based on **genetic markers** that **predict disease progression**, in particular noting non-responsive and toxicity predictions, we hope to **reduce** frequency of adverse events from **5%** to around **2%**. [7]



**"THE RIGHT DRUG,
WITH THE RIGHT DOSE
AT THE RIGHT TIME TO
THE RIGHT PATIENT" [7]**

Variable drug response is **multifactorial**, including age, sex, body weight, nutrition, organ function, infections, comedications and genetic factors. The study of **polymorphic metabolic enzymes, transporters and receptors** is another contributor to **targeting medicine** and **choosing appropriate drug targets**. [7]

Some Applications

Monoclonal Antibody (MAb) Therapies

Herceptin is useful in **20-30%** of patients with **breast cancer** and **elevated HER2 expression**, though patients with **mutated HER2** tend to be **drug resistant**; molecular **characterization** of genetic and epigenetic factors can **stratify patients** for **optimal use**. [6]



Immunotherapy in Clinical Practice

Sipuleucel(Provenge) is used to **extract dendritic cells** for incubation and maturation in the **presence** of the **prostatic acid phosphatase (PAP)** enzyme, present on over **95%** of **prostate cancer** cells, so that when they are reintroduced into patient blood, they guide immune response to target and attack tumours. [1]

CRISPR-Cas9 Gene Editing

Ex-vivo modification of **oncogenes** could allow for the creation of treatments that take into account **unique tumor evolution pathways** for in a patient-specific way. This **genetic engineering** is advancing and undergoing clinical trials. [2]

