J Ment Health Disord. 2026;6(1):143–145.

Journal of Mental Health Disorders Commentary

Biotechnology and Its Impact on the Diagnosis and Treatment of Mental Health Disorders

Ursula Steiner[1,*]

[1]Bregenz, Austria

[*]Correspondence should be addressed to Ursula Steiner, IKHLP@yahoo.com

Received date: October 01, 2026, **Accepted date:** November 04, 2026

Citation: Steiner U. Biotechnology and Its Impact on the Diagnosis and Treatment of Mental Health Disorders. J Ment Health Disord. 2026;6(1):143–145.

Copyright: © 2026 Steiner U. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Abstract

When people think about biotechnology, most associate it with genetically modified foods. However, 50% of biotechnology applications are related to the medical sector in Germany. This branch is also called red biotechnology. In 2003, Dr. Rita Colwell started to categorize biotechnology in different colors such as red biotechnology. Red biotechnology uses biotechnological techniques, such as genetic engineering, to develop new medicines and vaccines.

This raises the question of how red biotechnology is related to mental health disorders. Researchers can identify genes which increase the risk of psychiatric disorders. Doctors may find certain patterns in genetic makeup potentially before severe symptoms develop. This leads to the development of so called biopharmaceuticals consisting of tailored antibodies and proteins which are designed to act effectively within the body.

Considering an individual's genetic makeup enables the development of personalized medicine. In the following sections the relevance of biomarkers, genetic engineering, and stem cell research highlights the importance of biotechnology in understanding and treating mental health disorders. These advances may pave the way for significant breakthroughs in the future.

Keywords: Red biotechnology, Personalized medicine, Biomarkers, Genetic engineering, Stem cell research

Introduction

Biotechnology has the potential to improve the accuracy and precision of diagnosing and treating mental health disorders [1]. This statement is underlined by cutting edge research and the new progress that has been made in the field of biomarkers (fMRI), genetics (CRISPR-Cas), and stem cell research (neural plasticity). However, the transition from "bench to bedside" [2,3], it is still a long way to go. It is well established that not all drugs are effective for patients suffering from mental health disorders [3] due to the complexity of the illness and therefore makes it difficult to treat these disorders when compared to a physical illness. Therefore, biotechnology may aid in devising a more precise approach for the diagnosis and treatment of psychological disorders.

To illustrate in greater detail the relationship between red biotechnology and mental health disorders, the most commonly used techniques are described in the following sections.

Biomarkers

Biomarkers are measurable biological parameters which are used to support diagnostic and clinical decision-making in medicine. Biomarkers can be genes, cells, molecules, enzymes, and hormones. Biomarkers can be broadly classified into disease-related and treatment-related biomarkers. Disease-related biomarkers typically indicate whether an illness has already occurred or how it may progress (prognostic biomarker) [2]. On the other hand, treatment-related biomarkers indicate how a certain medicine shows an effect on a patient. The most common biomarker is the complete blood count (CBC).

Proteins that are found in blood, plasma, and tissue may provide valuable information about mental health disorders

such as depression, bipolar disorder, and anxiety [4]. However, the development of genetically tailored pharmaceutical treatments for these conditions is still in its infancy.

Some examples of biomarkers which are relevant to mental health disorders are as follows. Dysregulation of the immune system, indicated by elevated levels of inflammatory markers in the blood, such as interleukin-6 (IL-6), may be associated with various psychiatric conditions, including depression, bipolar disorder, schizophrenia, and psychosis [1,2]. Protein SNAP-25 at certain concentrations has been associated with depression and schizophrenia. The hair cortisol is a long term indicator of chronic stress and its risks for depression.

However, mental health disorders are influenced by multiple factors, including social and environmental factors, and therefore cannot be explained or assessed solely through biomarkers [1,3]. The combination of biomarker research and genetic engineering offers promising opportunities for personalized medicine. Biomarkers can help identify specific biological characteristics associated with a disorder, while genetic engineering may contribute to the development of targeted therapeutic approaches. Together, these advances could support progress towards more personalized diagnosis and treatment strategies for mental health disorders [2].

Genetic Engineering

CRISPR-Cas (Clustered Regularly Interspaced Short Palindromic Repeats-associated proteins, with Cas referring to CRISPR-associated enzymes) can target specific genes associated with mental health disorders. Genetic modifications which can be found in schizophrenia, autism, and bipolar disorder can be modelled in laboratory cell systems to investigate their underlying biological mechanisms. However, the application of this technology raises important ethical questions, particularly regarding the safety and implications of genetic modifications in humans. Emmanuelle Charpentier and Jenniver Doudna received the Nobel Prize for Chemistry in 2020 for their research on CRISPR-Cas technology. More recently, a CRISPR-based treatment, Casgevy has been introduced at the Charité in Berlin to treat patients suffering from sickle cell anemia.

This shows the enormous future potential of CRISPR-Cas technology. Currently scientists are focusing on genetic risk variants related to schizophrenia, autism, and depression. CRISPR-Cas technology allows researchers to modify multiple genes and investigate how these genetic changes affect communication between brain cells. Nevertheless, mental health disorders cannot be attributed solely to defective genes. A mental health disorder is influenced by innumerable genetic variations, environmental and social factors, and brain development. For example, CACNA1C gene has been investigated as potential biomarker for psychiatric conditions, including schizophrenia, bipolar disorder, and depression. Interestingly, many mental health disorders are associated with certain genes and mutations, and this phenomenon is known as polygenic overlap [5,6]. Therefore, genetics represents only one piece of a much larger puzzle in the diagnosis and treatment of mental health disorders.

In the context of genetic engineering, epigenetics should not be missed. Epigenetics examines how behavioral and environmental factors, such as stress, trauma, and diet, can influence gene expression without altering the underlying DNA sequence. For example, chronic stress can lead to changes in the production of certain proteins and neurotransmitters in the brain. Furthermore, mental health disorders can affect how individuals respond to and cope with stress, and these effects may be reflected in changes in gene expression.

Pharmacogenetics uses the genetic make-up of an individual to explore how they may respond to a particular drug, including its effectiveness and tolerability. This analysis can help in reducing side effects by taking into account genetic variations that influence drug-metabolizing enzymes, brain receptors, and transporters. For example, the gene CYP2D6 plays an important role in the metabolism of atomoxetine which is an antidepressant used to treat attention-deficit/hyperactivity disorder (ADHD). This shows the contribution of red biotechnology to the development of personalized medicine [7,8].

An important part of pharmacogenetics is pharmacokinetics (PK). It examines how the body processes a drug through absorption, distribution, metabolism, and excretion (ADME) [7]. Whereas pharmacodynamics focuses on the biochemical, physiological, and molecular interactions between a drug and the body. Both Pharmacokinetics and pharma dynamics are indispensable for the further development and research of biotechnological drugs [7].

It is worth mentioning that the Nobel Prize Committee has recently nominated optogenetics as a breakthrough for curing inherited retinal diseases. Researchers hope that optogenetics will contribute to future therapeutic approaches for neurological conditions, including Alzheimer's and Parkinson's diseases.

Stem Cell Research

There are many mental health disorders which are triggered by the nervous system such as depression, Alzheimer's disease, anxiety disorders, and multiple sclerosis. Genetic engineering cannot be applied in this case. Therefore, stem cell research is important area of biotechnology that deserves attention. Stem cell research is the third important pillar besides biomarker analysis and the investigation of genetic makeup.

Stem cell research allows researchers to study neuronal processes and their disturbances, providing valuable insights into the underlying mechanisms of mental health disorders such as schizophrenia, bipolar disorder, and depression. Stem cell therapy tries to replace damaged tissue by boosting the regeneration of nerve cells. It is also called neural plasticity and is a very promising novel therapy [3]. Certain types of stem cells may help in regulating inflammation in the brain and reduce stress. Stem cells support neural pathways through the release of proteins and signaling molecules that promote communication between nerve cells. The impaired functioning of neurotransmitter systems, particularly those involving serotonin, norepinephrine, and dopamine which regulate our mood is a biomarker for depression [3]. This fact makes the relationship between stem cells and biomarkers obvious. However, stem cell-based therapies also involve certain risks, including the possibility of uncontrolled cell growth and tumor formation. Furthermore, their application in treating mental health disorders remains largely experimental and requires further clinical research to establish their safety and effectiveness.

Conclusion

Red biotechnology offers a wide range of diagnostic tools as discussed in this article (biomarkers, CRISPR-Cas, epigenetics, and stem cell research). These approaches can contribute to a more accurate understanding and diagnosis of complex mental health disorders while taking social and environmental factors into consideration. Unlike physically illnesses it is much more difficult to develop safe therapies (neural plasticity, CRISPR-Cas) and drugs (personalized medicine) for mental health disorders. Several aspects discussed in the studies by Nirdosh Jagota closely align with the focus of this publication. Jagota discusses pharmacogenetics in the context of personalized medicine, the correction of genetic mutation using CRISPR-Cas technology, and the application of stem cells to repair damaged brain tissue. He also mentioned importance of ethical considerations in the application of biotechnology. In particular, he raises questions about whether patients are sufficiently informed and able to fully understand and evaluate the potential benefits and risks of complex biotechnological treatments. Furthermore, personalized biotechnological treatments often involve substantial costs, which may widen the gap between high-income and low-income countries in terms of access to innovative treatments for mental health disorders [4].

In contrast to our approach, Jagota [9], Sagar et al. [2] and Sahmabdi et al. [1] also discuss neuroimaging techniques such as fMRI (functional magnetic resonance imaging) and PET (positron emission tomography). These techniques can provide valuable insights into brain activity and support more accurate diagnoses, as well as the monitoring of treatment responses. In particular, neuroimaging may be valuable in the diagnosis and management of bipolar disorder (BD) [2]. Furthermore, advances in digital technology make it possible to analyze large datasets and develop applications that support patients throughout their treatment [2]. The usage of artificial intelligence for biotechnological purposes is referred to as gold biotechnology. The combination of artificial intelligence and biotechnology can therefore accelerate scientific research and the development of innovative diagnostic and therapeutic approaches [1,2,9].

Finally, if this article helps readers gain a new understanding of the relationship between biotechnology and mental health disorders—one they may not have considered before—this article will have achieved an important objective. By presenting complex scientific concepts in an accessible and concise manner, it aims to open up new perspectives on the future of mental healthcare.

Conflicts of Interest

The author has no conflict of interest to declare.

References

1. Shamabadi A, Hasanzadeh A, Akhondzadeh S. Integrating Psychiatry and Medical Biotechnology as a Way to Achieve Scientific, Precision, and Personalized Psychiatry. Avicenna J Med Biotechnol. 2021 Oct-Dec;13(4):172–5.
2. Sagar R, Pattanayak RD. Potential biomarkers for bipolar disorder: Where do we stand? Indian J Med Res. 2017 Jan;145(1):7–16.
3. Villanueva R. Stem cell therapy for the treatment of psychiatric disorders: a real hope for the next decades. Front Psychiatry. 2025 Jan 7;15:1492415.
4. Hopkins L. The Role of Biotechnology In Mental Health Treatment [Internet]. EFB Public; 2024. Available from: https://www.efbpublic.org/biotechnology-in-mental-health-treatment
5. Grotzinger AD, Werme J, Peyrot WJ, Frei O, de Leeuw C, Bicks LK, et al. Mapping the genetic landscape across 14 psychiatric disorders. Nature. 2026 Jan;649(8096):406–15.
6. Gutiérrez-Rodríguez A, Cruz-Fuentes CS, Genis-Mendoza AD, Nicolini H. CRISPR/Cas9 Genome Editing Approaches for Psychiatric Research. Braz J Psychiatry. 2023 May 11;45(2):137–45.
7. Bishop JR, Schneiderhan ME, Butler T, Carpentier RM, Heins KR, Formea CM. Pharmacogenomics to support mental health medication therapy management: Clinical practice considerations and a conceptual framework to enhance patient care. J Am Coll Clin Pharm. 2024 Feb;7(2):160–70.
8. Steiner U. Fachenglisch für BioTAs und BTAs. Berlin, Heidelberg: Springer; 2020 Jul 6.
9. Jagota N. Biotechnology's Role in Mental Health treatment. 2024.