

Rapid Detection of PTSD-Associated DNA Methylation: Toward Faster Diagnosis and Treatment

A Novel High-Speed Method for Single-Base DNA Methylation Detection and Quantification

Surface Plasmon Resonance Imaging-Based Platform Enables Detection of Single, Site-Specific 5-Methylcytosine Associated with Post-traumatic Stress Disorder (PTSD) | ACS Pharmacology & Translational Science



Our ability to detect a single methyl group on a single base of a specific gene in whole blood is the equivalent of finding a needle in a haystack. Equally amazing is our ability to simultaneously measure the amount of methylation present. This precise identification and quantification capability, combined with the speed of our approach, represents a significant advance over current methods, enabling faster risk assessment, diagnosis, and treatment.

Christopher Tison, PhD, Director of Biotech, Luna Labs



DNA methylation is the study of chromosomal patterns of DNA or histone modification by methyl groups. Epigenetic modifications, such as DNA methylation, can be associated with disease cause, onset, clinical course, and treatment response, helping track everything from early warning signs to treatment effectiveness. While most DNA methylation studies have focused on cancer research, there are growing efforts to determine its role in military-relevant indications such as post-traumatic stress disorder (PTSD) and traumatic brain injury (TBI).

The Luna Labs' biotech team has developed a faster, simpler way to detect epigenetic modifications related to PTSD, reducing DNA methylation identification from 4 days (using standard approaches) to 9 hours. This breakthrough method, funded by the Department of Defense SBIR

program and published in ACS Pharmacology & Translational Science, removes many of the complex and time-consuming steps previously needed.

PTSD is a psychobiological mental condition initiated by distressing events such as combat, natural disasters, and major emotional experiences. The scope of this health challenge is significant:

- 70% of U.S. adults (223 million people) have experienced at least one traumatic event; 14% of those exposed to trauma develop PTSD¹
- Military populations show particularly high prevalence of developing PTSD²:
 - 23% of Iraq and Afghanistan veterans (OEF/OIF)
 - 10% of Gulf War veterans
 - 30% of Vietnam War veterans.

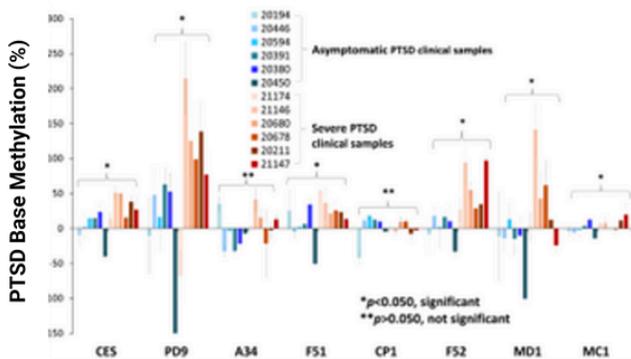
In addition to the toll on human life, the economic impact is substantial:

- First-year treatment costs for Iraq and Afghanistan veterans exceed \$2 billion (\$8,300 per person)³
- Civilian treatment costs range from \$10,960 to \$18,753 per patient annually⁴
- Only 30% of patients achieve complete remission with current treatments.⁵

Introducing Luna Labs' EpiNanoSPRI: A Novel Image-Based Epigenetic Assay

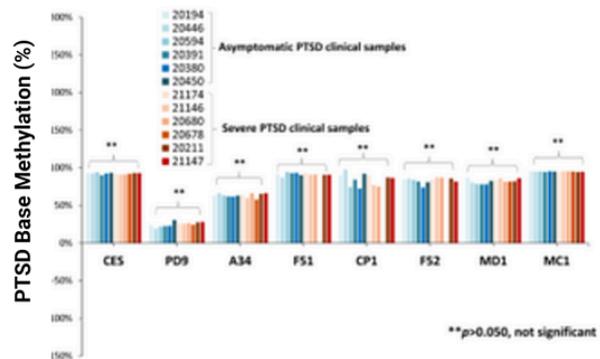
Typical DNA sequencing techniques require a complex series of steps that take 3-4 days to complete. Luna Labs' EpiNanoSPRI™ (nanoenhanced surface plasmon resonance imaging-based epigenetic assay platform) enables single-base DNA methylation identification as well as quantification of the extent of DNA methylation – all in 9 hours.

Our research study demonstrates the simultaneous detection of single, site-specific methylated DNA in eight target genes associated with PTSD. It significantly distinguishes between asymptomatic and severe PTSD clinical samples and is faster and more simplified than conventional DNA sequencing.



Methylated Bases in Genes Associated with PTSD

Methylation signals (blank-subtracted) for the eight PTSD-associated bases in asymptomatic and severe samples analyzed using the EpiNanoSPRI platform



Methylated Bases in Genes Associated with PTSD

Methylation signals (blank-subtracted) for the eight PTSD-associated bases in asymptomatic and severe samples analyzed using the MethylationEPIC v2 BeadChip method

Comparison of signal differences between severe PTSD and asymptomatic samples using EpiNanoSPRI and MethylationEPIC v2 BeadChip. Data shows higher signal differences of 8 PTSD biomarkers using EpiNanoSPRI as well as severity differentiation.

Overall benefits of this approach include:

- Reduced analysis time from 4 days to 9 hours
- Direct identification of site-specific methylation
- Single-base resolution
- Simultaneous analysis of multiple target genetic regions
- Quantification of the extent of DNA methylation

Our EpiNanoSPRI technology is a simple, highly sensitive blood test that can detect PTSD by measuring site-specific epigenetic markers. Unlike traditional PTSD diagnoses that rely on interviews and questionnaires, our approach provides objective, biomarker-based results.

Judy M. Obliosca, PhD
Principal Investigator, Luna Labs

Looking Forward

This approach enables the study of epigenetic markers that could improve risk assessment, diagnosis, monitoring, and treatment for PTSD. Like PTSD, TBI represents a significant concern for military personnel.

A recent [New York Times article](#)⁶ shed light on the Navy's interest in better understanding how various aspects of military service, such as repeated exposure to extreme G-forces, may affect brain health and cause TBI.

Beyond PTSD and TBI, the platform could be used to study other disorders such as Alzheimer's, Parkinson's, dementia, schizophrenia, and Huntington's diseases, and potentially extended to sample matrices such as saliva and cerebrospinal fluid.

For information about research collaboration opportunities or next steps, please contact Chris Tison, Director of Biotech, at chris.tison@lunalabs.us.

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