

CASE STUDY #2

Immune Hub Gene Discovery Using Transcriptomic Network Analysis

Project Type

Independent outcome-driven re-analysis of public GEO transcriptomic datasets for immune biomarker discovery.

Problem

Chronic kidney transplant rejection involves complex immune mechanisms. Single-gene biomarkers show limited reproducibility, and many transcriptomic studies remain descriptive without network-level interpretation. Researchers require robust, reproducible immune signatures supported by network biology and cross-dataset validation.

Dataset

- 1 Discovery: Microarray kidney biopsy transcriptomes (GSE192444)
- 2 Rejection vs Non-rejection phenotypes
- 3 dd-cfDNA and DSA available
- 4 Validation: Independent RNA-seq dataset (GSE261892)

Solution

Performed multi-layer transcriptomic analysis integrating differential expression, WGCNA co-expression networks, hub gene prioritization, functional enrichment, and cross-platform validation.

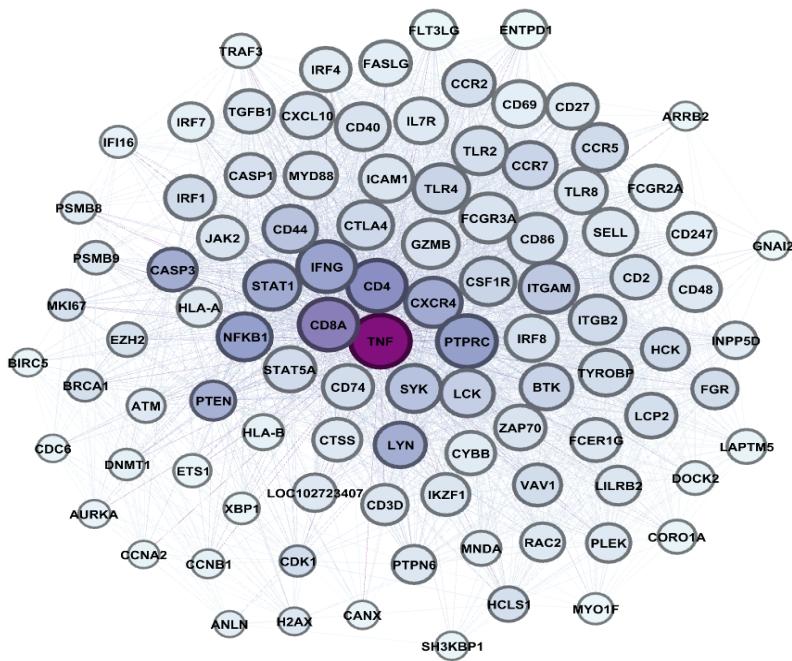
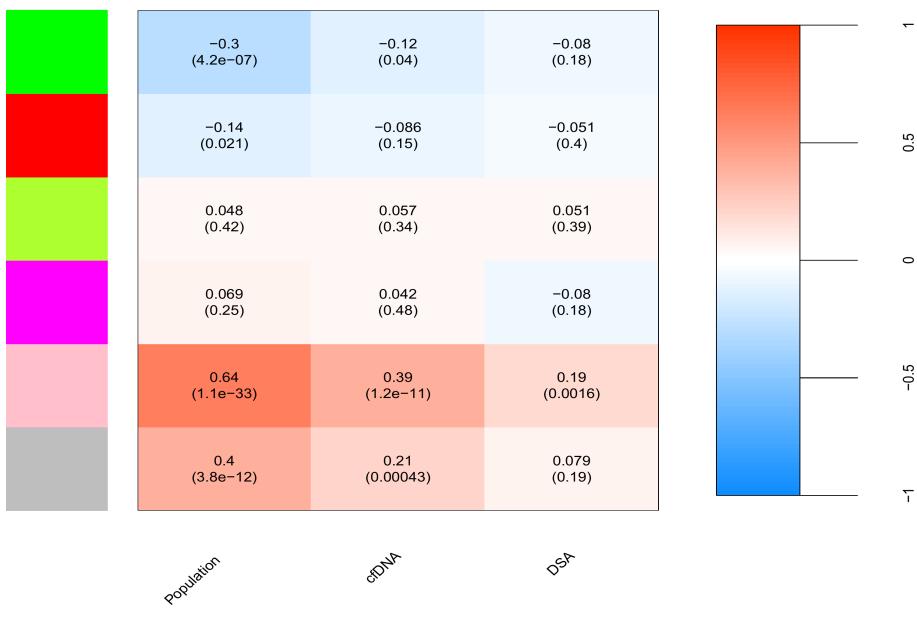
What I Delivered

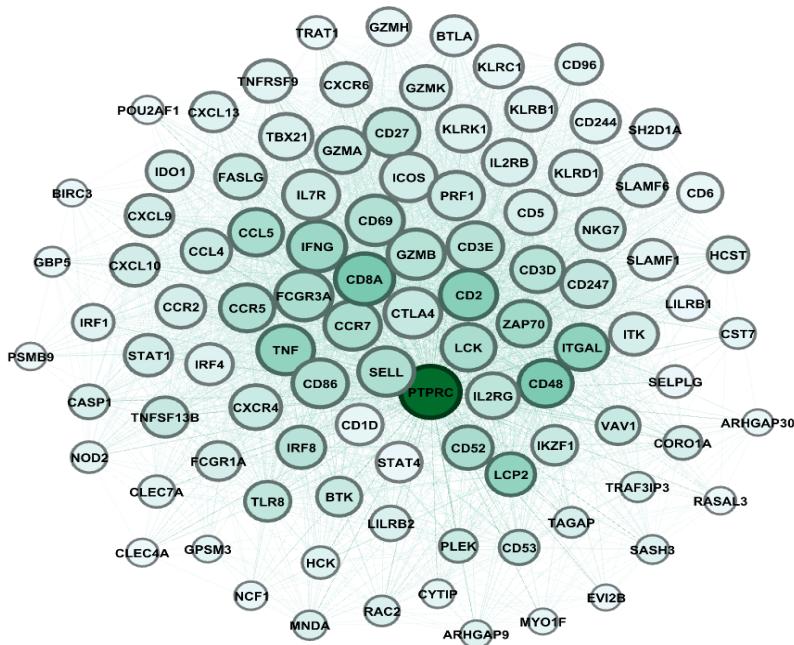
- 1 Disease-associated co-expression modules
- 2 Immune-enriched hub gene networks
- 3 Cross-dataset validated gene signature
- 4 Prioritized biomarker gene panel

Key Results

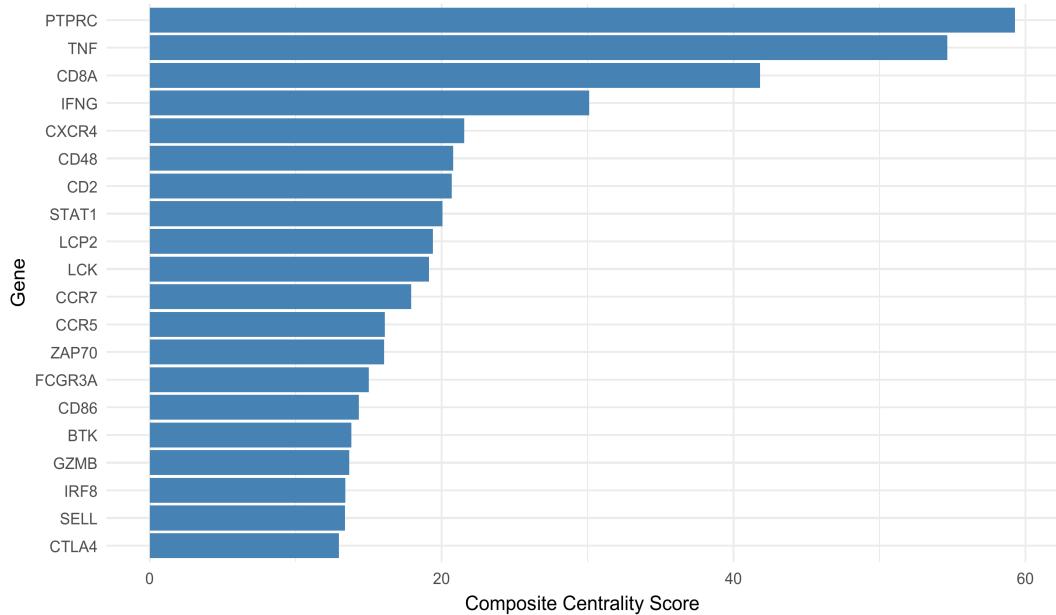
- 1 Immune module strongly associated with chronic rejection
- 2 Top 100 hub genes extracted from network
- 3 257 genes validated in independent RNA-seq cohort
- 4 Final prioritized panel of 20 robust hub genes
- 5 Enriched pathways: TCR signaling, BCR signaling, interferon signaling, antigen processing & presentation

Representative Figures





Top 20 Shared Hub Genes Ranked by Centrality-Based Composite Score



Impact

Converted large transcriptomic datasets into interpretable immune networks, delivered reproducible biomarker candidates, and provided mechanistic insight into rejection biology. Framework transferable to oncology and immunotherapy datasets.

How This Helps Clients

For RNA-seq or microarray cohorts, I provide network-based biomarker discovery, hub gene identification, cross-dataset validation, and biomarker-ready gene panels.