NTOU CSE 資訊工程學系 COMPUTER SCIENCE AND ENGINEERING

智慧生醫實驗室

BioMedical AI Laboratory

實驗室網站

指導老師： Kuan Y. Chang (張光遠)　kchang@ntou.edu.tw

Ting-Yu Wang (王庭宇), Ai-Ke Chang (張艾可), Yan-Cheng Lai (賴彥丞), Yu-Sung Liu (劉育菘)
Kai-An Hsiao (蕭鍇安), Yao-Chun Yeh (葉耀鈞), Ahmed Alkuraimi (庫瑞明)

RESEARCH SPOTLIGHT

SARS-CoV-2 Research（新冠病毒研究）

Predicting 3-month infection susceptibility from pre-exposure serum proteins

PreRisk-CoV2
7-Protein Biomarker Panel

01 Background

- SARS-CoV-2 infection susceptibility varies among individuals and is influenced by host immune responses.
- Serum proteins reflect physiological and immunological states, making them promising biomarkers for predicting infection risk.
- Most existing proteomic studies focus on post-infection diagnosis and disease severity rather than pre-exposure susceptibility.

02 Motivation

Identifying reliable protein signatures could enable early risk stratification and support personalized preventive strategies.

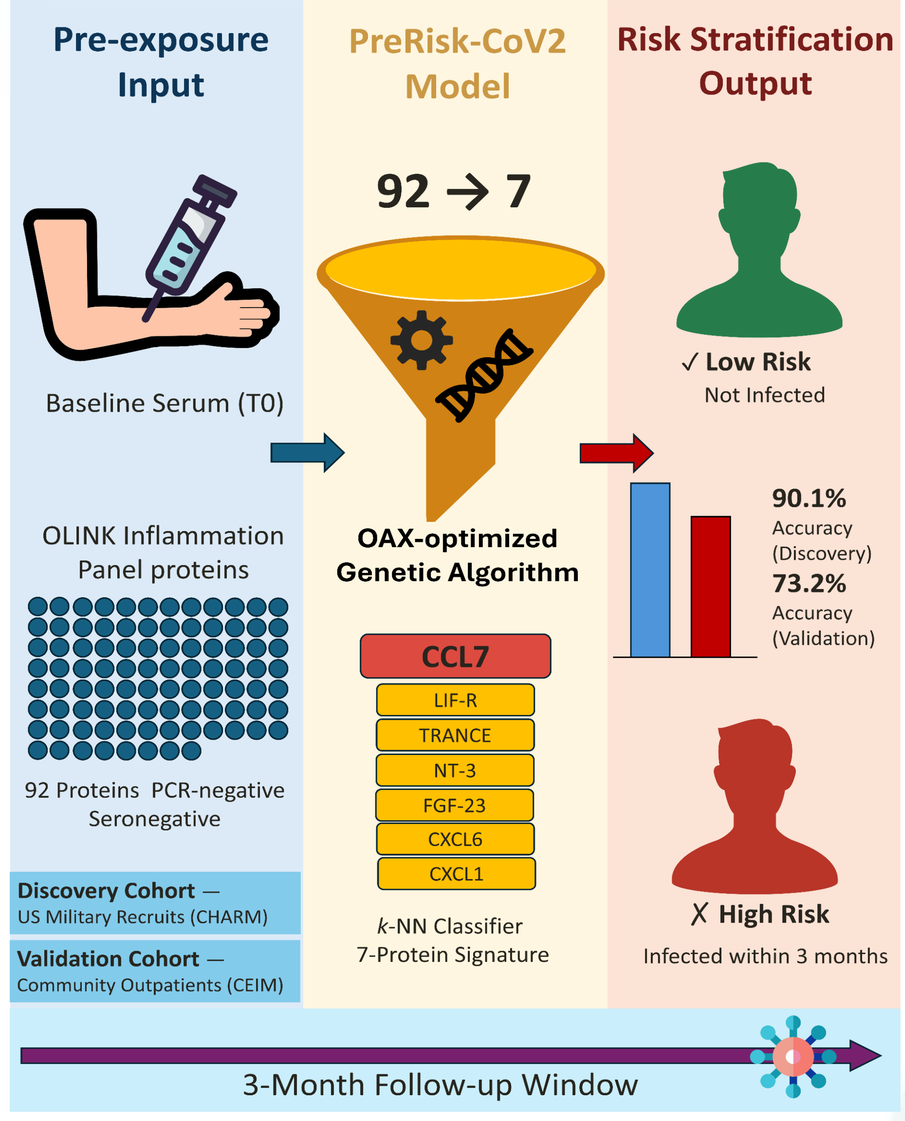
Aim Develop a machine-learning framework for predicting 3-month SARS-CoV-2 infection susceptibility using pre-exposure serum proteins.

03 Materials

77
Discovery Cohort
CHARM · GSE198449
57 infected · 20 uninfected

18
External Validation Cohort
CEIM · GSE178967
9 infected · 9 uninfected

92
Serum Proteins
Olink Target 96 Inflammation
Baseline (T0) profiles



04 Method: PreRisk-CoV2

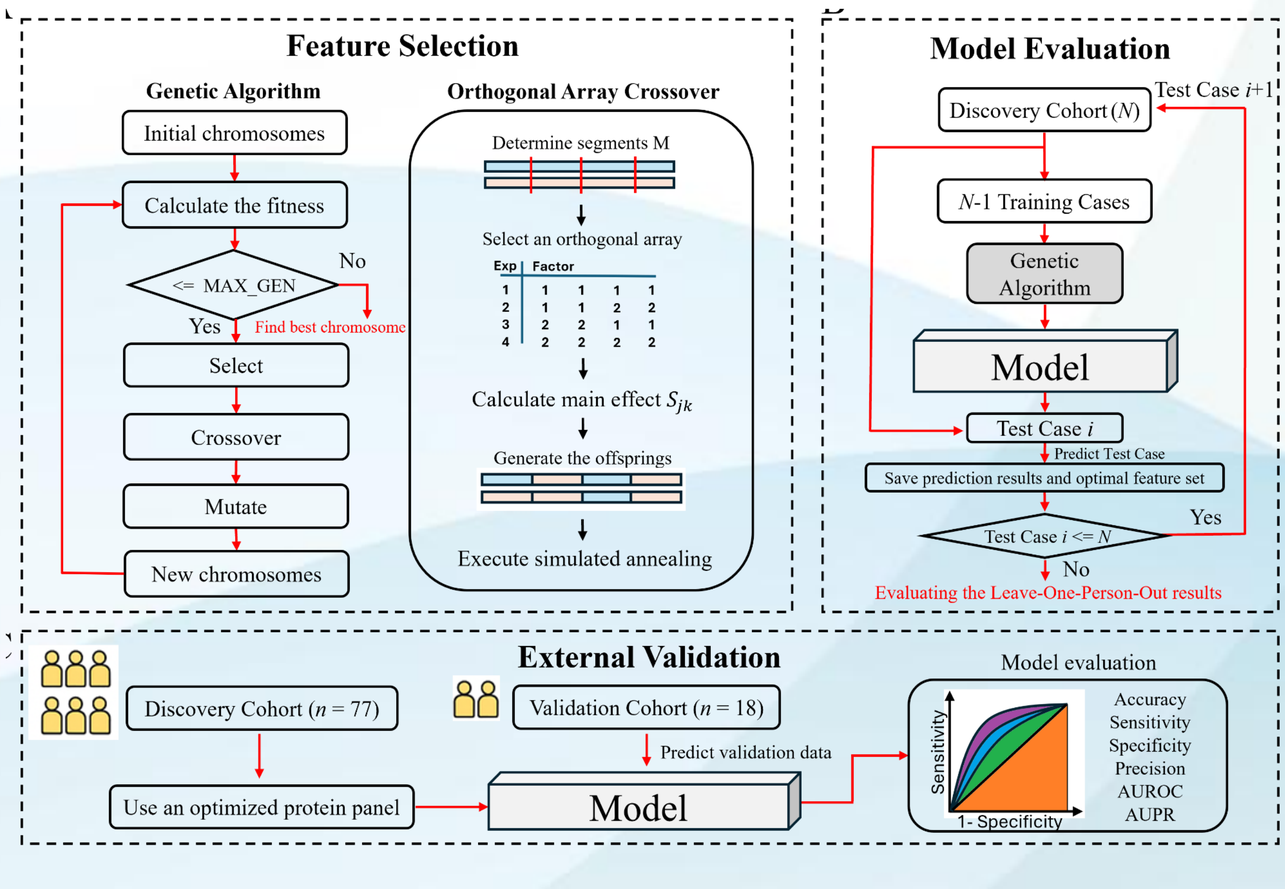
1 Data Preprocessing
Min-max normalization and SMOTE for class balancing during model training.

2 Feature Selection
Genetic Algorithm (GA) enhanced with Orthogonal Array Crossover (OAX) and Simulated Annealing (SA).

3 Classification
k-Nearest Neighbors (k-NN) using the selected protein biomarkers.

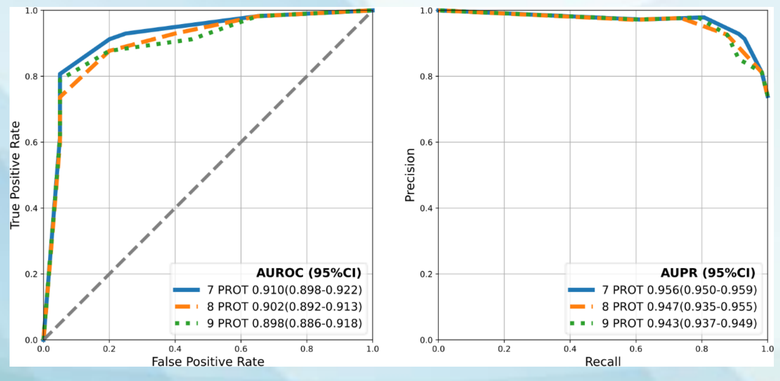
4 Internal Validation
Leave-One-Out Cross-Validation (LOOCV) on the discovery cohort.

5 External Validation
Independent evaluation using the CEIM cohort.

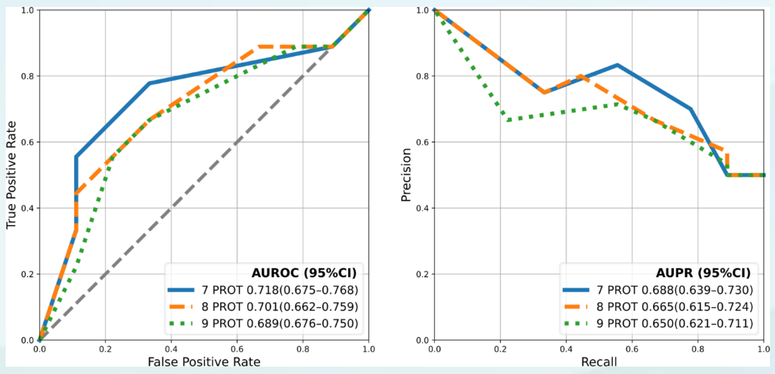


05 Results

Internal validation · LOOCV



External validation · CEIM



Evaluation Metric	Internal Validation	External Validation
Accuracy	**90.1%**	**73.2%**
AUROC	0.910	0.718
AUPR	0.956	0.688

Key Findings

- The seven-protein panel demonstrated promising predictive performance in internal and external validation.
- CCL7/MCP-3 emerged as a key predictive biomarker.

NSTC 國家科學及技術委員會 National Science and Technology Council

R.O.C. NSTC Grant No. 115-2221-E019-048