

S1. The influenza datasets used in this study can be found at the following link:

<https://github.com/Rayin-saber/ViPal/tree/main/data>

S2. Table: The division of amino acid groups based on physicochemical properties and amino acid indices.

Attributes	Group 1	Group 2	Group 3
Hydrophobicity	Polar Q, E, R, K, D, N	Neutral G, P, H, A, S, T, Y	Hydrophobic C, V, F, L, I, M, W
Polarizability	0-1.08 S, D, G, A, T	0.128-0.186 C, Q, I, P, N, V, E, L	0.219- 0.409 Y, M, K, R, H, F, W
Normalized Van der Waals	0-2.78 S, C, G, A, T, P, D	2.95-4.0 E, Q, N, V, I, L	4.0-8.1 K, F, M, H, R, Y, W
Polarity	4.9-6.2 W, C, L, I, F, M, V, Y	8.0-9.2 T, G, P, A, S	10.4-13.0 K, N, H, Q, R, E, D
Solvent Accessibility	Buried A, I, F, C, G, L, V, W	Exposed R, K, Q, E, N, D	Intermediate M, S, P, T, H, Y
Secondary Structure	Helix E, A, L, M, Q, K, R, H	Strand V, I, Y, C, W, F, T	Coil G, N, P, S, D
Charge	Positive K, R	Neutral A, N, C, Q, G, H, I, L, M, F, P, S, T, W, Y, V	Negative D, E

S3. Table: Performance on different values of hyperparameters α and β on testing data for virulence prediction with ResNet-50*.

β ($\alpha=1$)	Testing data				
	Accuracy	Precision	Recall	F-score	AUC
0	0.745	0.824	0.836	0.83	0.512
0.1	0.745	0.824	0.836	0.83	0.515
0.2	0.745	0.824	0.836	0.83	0.524
0.3	0.745	0.824	0.836	0.83	0.528
0.4	0.745	0.824	0.836	0.83	0.528
0.5	0.745	0.824	0.836	0.83	0.527
0.6	0.745	0.824	0.836	0.83	0.529
0.7	0.745	0.824	0.836	0.83	0.529
0.8	0.735	0.822	0.822	0.822	0.53
0.9	0.745	0.824	0.836	0.83	0.528
1	0.693	0.693	0.693	0.693	0.693
2	0.735	0.822	0.822	0.822	0.544
3	0.735	0.822	0.822	0.822	0.55

β ($\alpha=1$)	Testing data				
	Accuracy	Precision	Recall	F-score	AUC
0	0.755	0.818	0.863	0.84	0.608
0.1	0.765	0.838	0.849	0.844	0.464
0.2	0.786	0.842	0.877	0.859	0.561
0.3	0.745	0.808	0.863	0.834	0.531
0.4	0.653	0.831	0.671	0.742	0.506
0.5	0.755	0.836	0.836	0.836	0.61
0.6	0.724	0.838	0.781	0.809	0.582
0.7	0.745	0.824	0.836	0.83	0.615
0.8	0.704	0.789	0.822	0.805	0.597
0.9	0.765	0.821	0.877	0.848	0.649
1	0.745	0.824	0.836	0.83	0.693
2	0.714	0.8	0.822	0.811	0.58
3	0.724	0.838	0.781	0.809	0.664
4	0.745	0.808	0.863	0.834	0.658
5	0.724	0.819	0.808	0.814	0.55