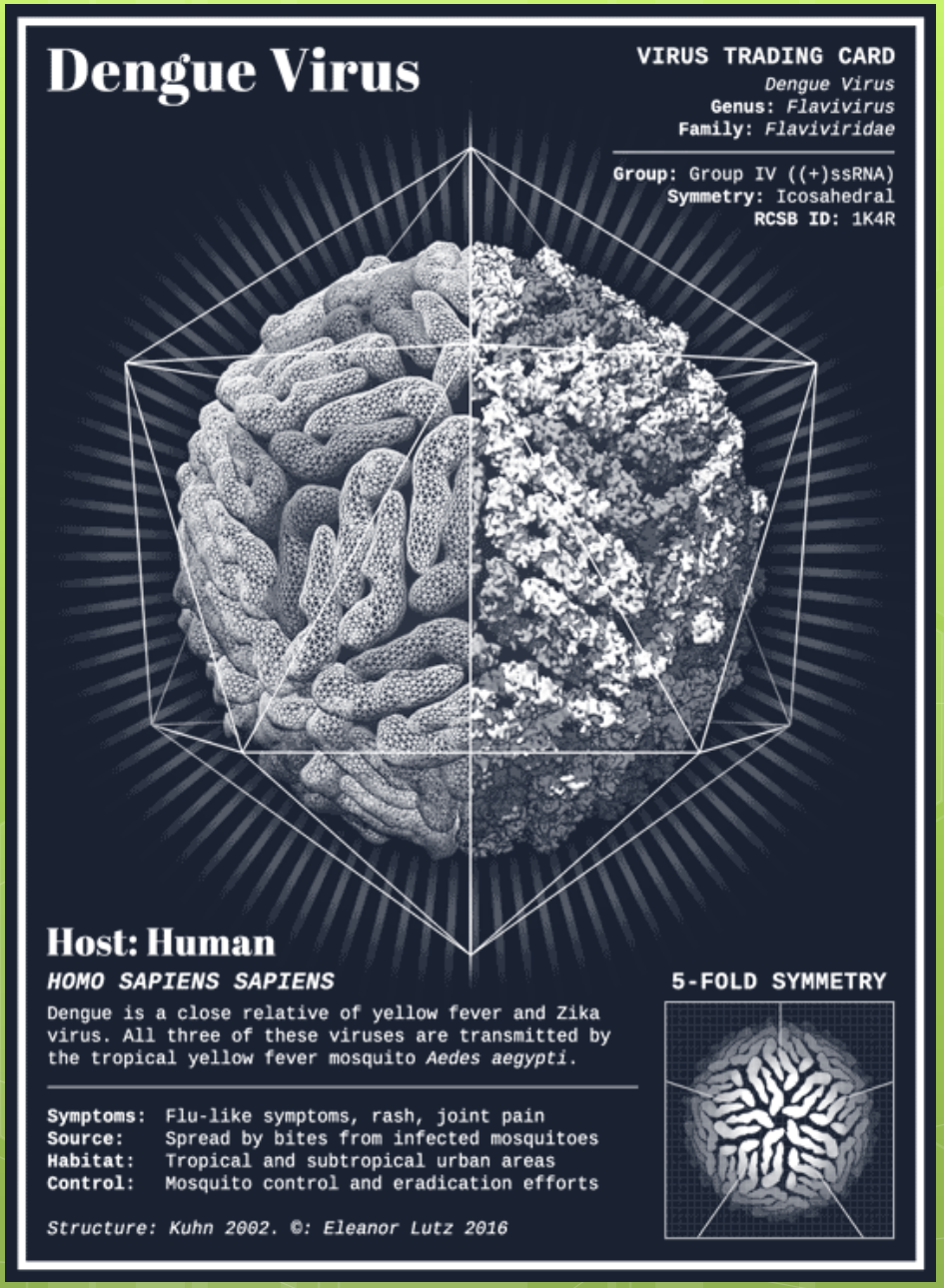


Dengue Virus Interaction Analysis

Table of Content

- What is Dengue & How it Transmits ?
- Objectives
- Understanding the Dataset
- Designing & Implementing ML Model.
- Studying the Results.
- Conclusions.

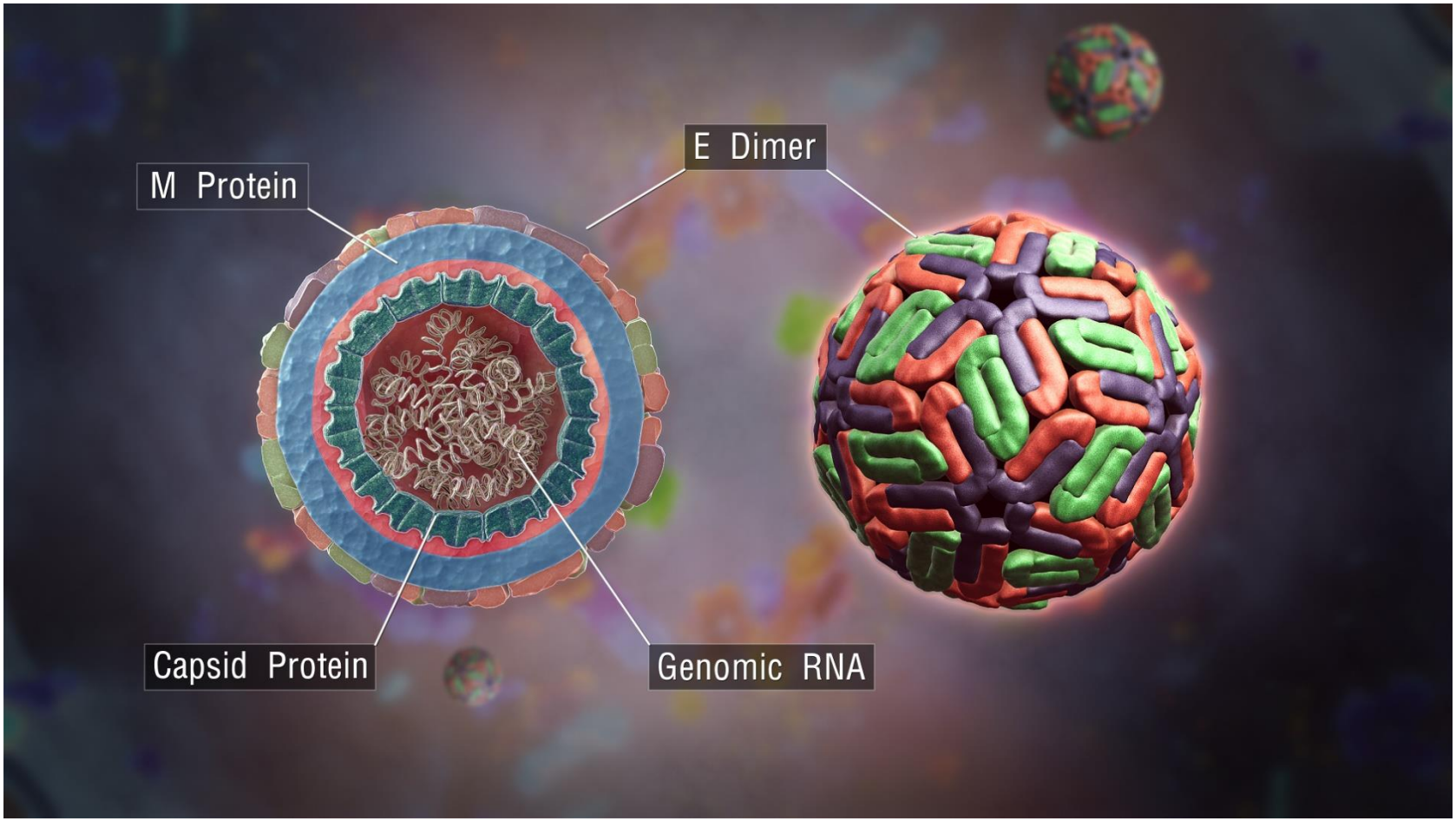
Objectives

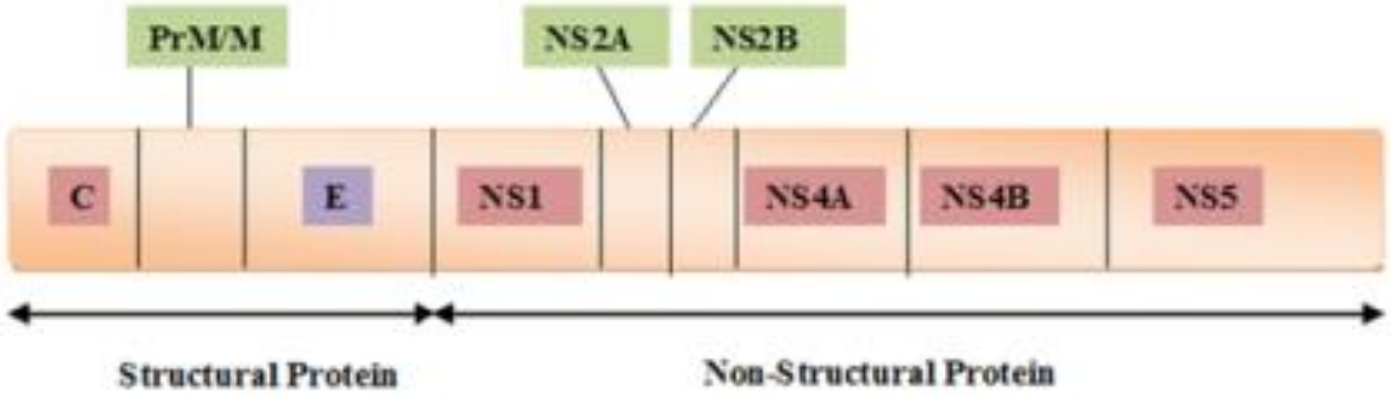
- Study Dengue Structure & Find Protein responsible for Maximum Human/Mosquito Interaction.
- Find out Human Genes which are cause of dengue in most cases.
- Given a human Gene Sequence can we classify which serotype & component its prone to?
- Are dengue serotypes viral component specific?
- Is Dengue spread in human & mosquito due to same viral component or different?
- Relation Between Dengue & Hemoglobin Deficiency.
- Serotype Specific Investigation.

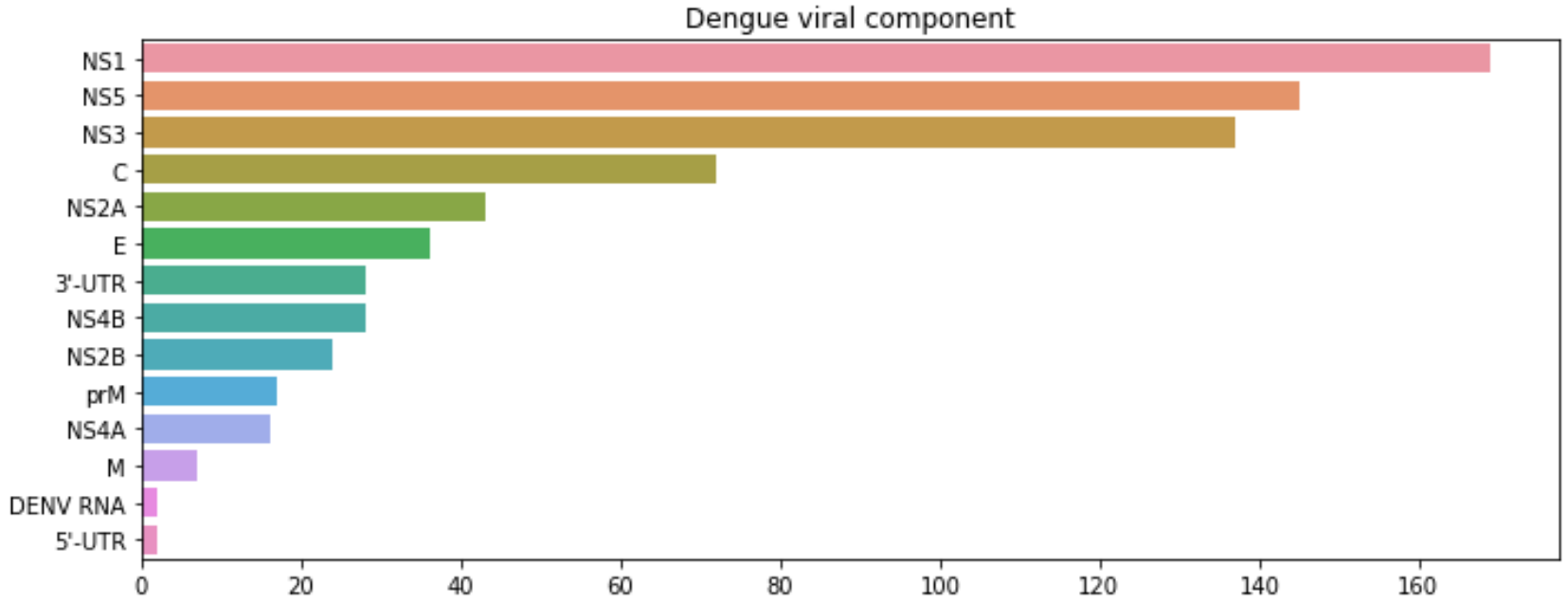
Understanding the Dataset

Dengue viral component	Human Gene symbol	Human gene Entrez Id	Pubmed Id	Serotype	System	Experiment	Title
3'-UTR	CALR	811	12584332	DENV4	U937	Crosslinking followed by immunoprecipitation a...	Cellular proteins from human monocytes bind to...
3'-UTR	PDIA2	64714	12584332	DENV4	U937	Crosslinking followed by immunoprecipitation a...	Cellular proteins from human monocytes bind to...
3'-UTR	SSB	6741	12584332	DENV4	U937	Crosslinking followed by immunoprecipitation a...	Cellular proteins from human monocytes bind to...
3'-UTR	TIA1	7072	17502609	DENV2	BHK-21	Co-immunoprecipitation, Western blot, Co-local...	Interaction of TIA-1/TIAR with West Nile and d...
3'-UTR	TIAL1	7073	17502609	DENV2	BHK-21	Co-immunoprecipitation, Western blot, Co-local...	Interaction of TIA-1/TIAR with West Nile and d...

Column 1 : Dengue Viral Component



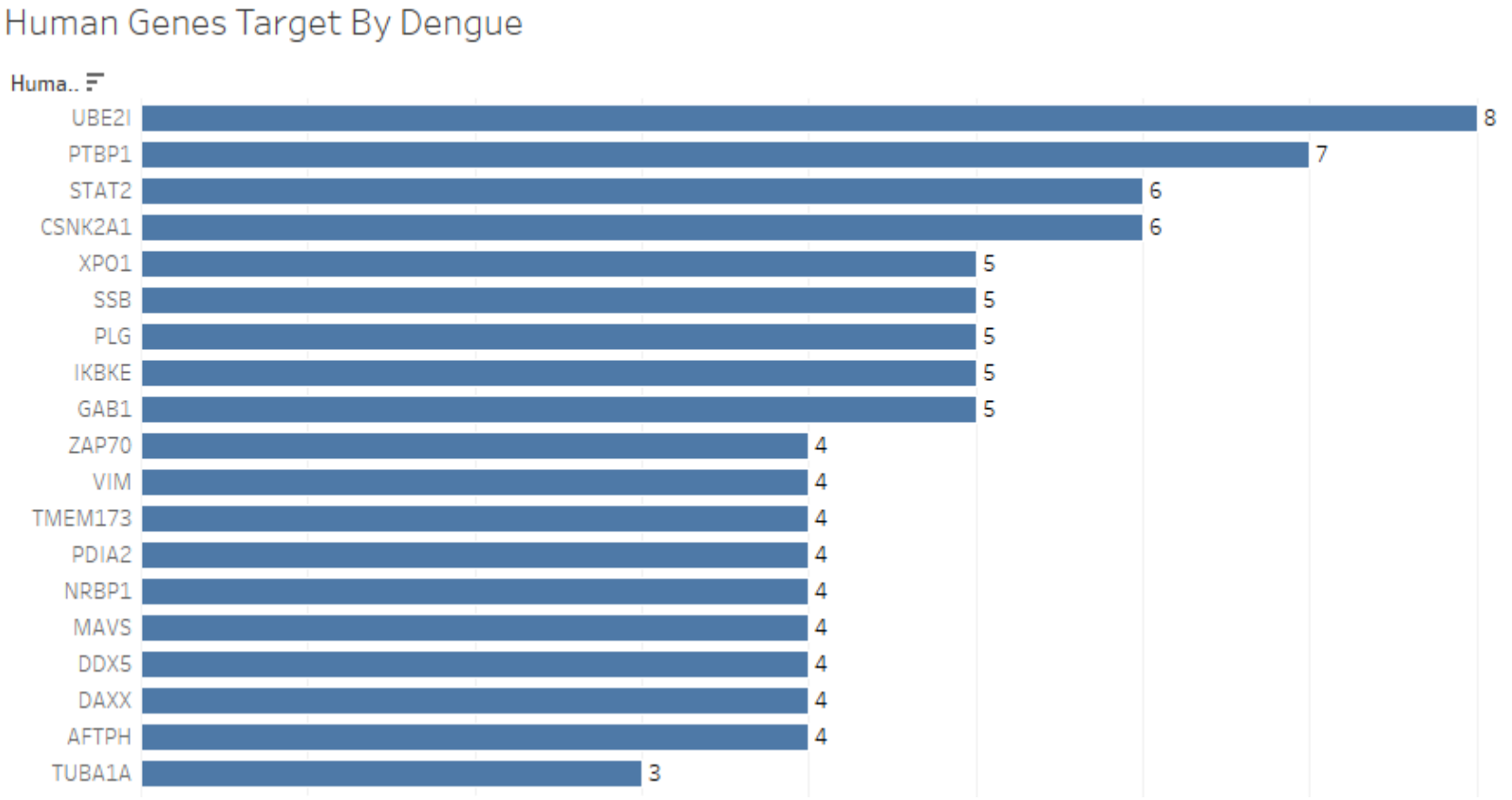

PrM/M
NS2A
NS2B
C
E
NS1
NS4A
NS4B
NS5
Structural Protein
Non-Structural Protein


Dengue viral component
NS1
NS5
NS3
C
NS2A
E
3'-UTR
NS4B
NS2B
prM
NS4A
M
DENV RNA
5'-UTR
0
20
40
60
80
100
120
140
160

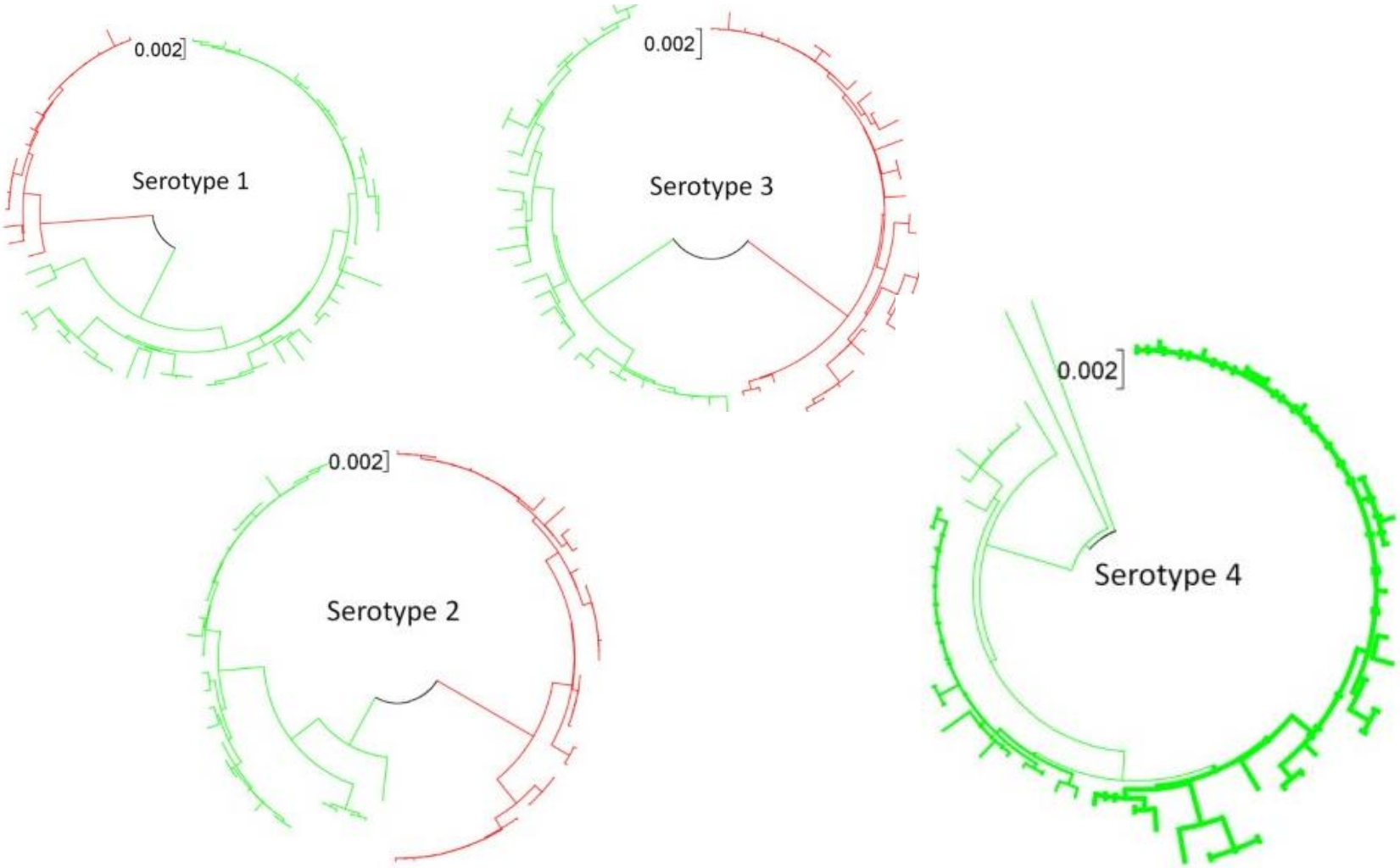
Dengue NS1 antigen testing

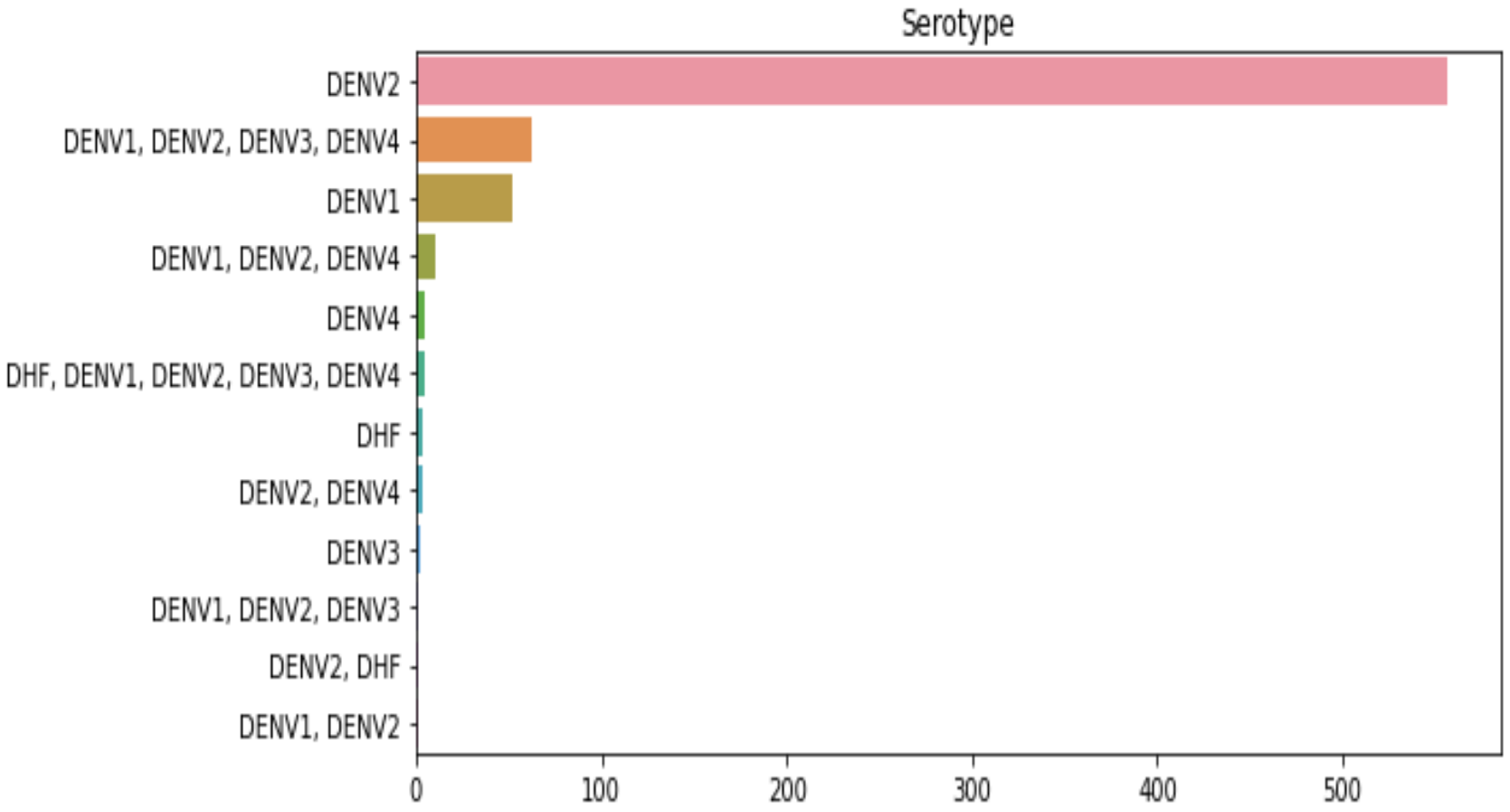
- Early detection of Ag NS1 in blood sample of infected patients > confirm early acute infection
- Detection of all 4 types of dengue serotypes
- Result available in 15 min. (BioRad® chromatographic strip test)
- High specificity (100%) and positive predictive value

Column 2 : Human Gene Symbol



Column 4 : Serotype

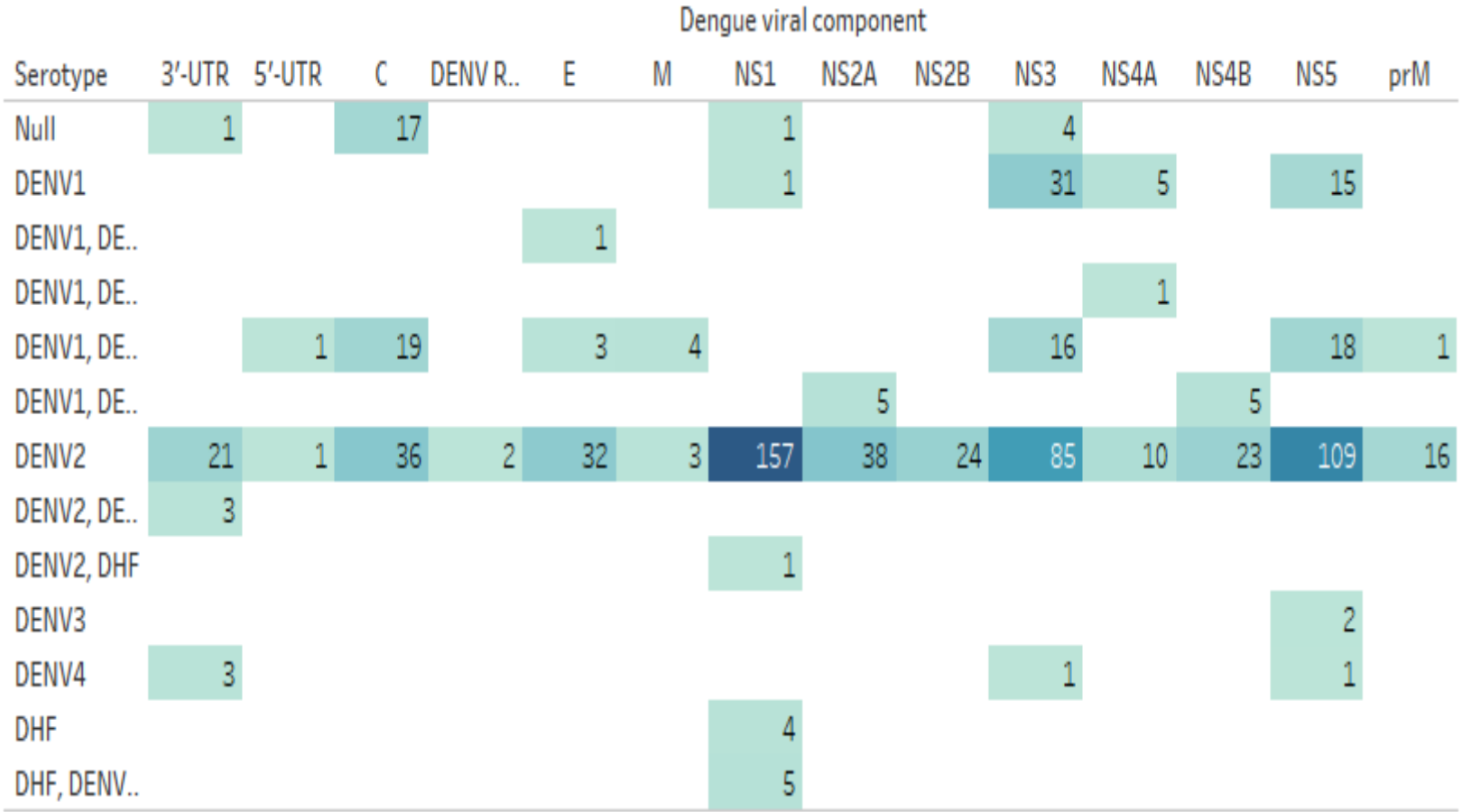



Serotype
DENV2
DENV1, DENV2, DENV3, DENV4
DENV1
DENV1, DENV2, DENV4
DENV4
DHF, DENV1, DENV2, DENV3, DENV4
DHF
DENV2, DENV4
DENV3
DENV1, DENV2, DENV3
DENV2, DHF
DENV1, DENV2
0
100
200
300
400
500

LGBM Classifier Model

- Best for Handling Categorical Data which may contain symbolic representations.
- Requires sufficient amount of data to train & is not good for small datasets.
- Accuracy depends upon Classes in Data

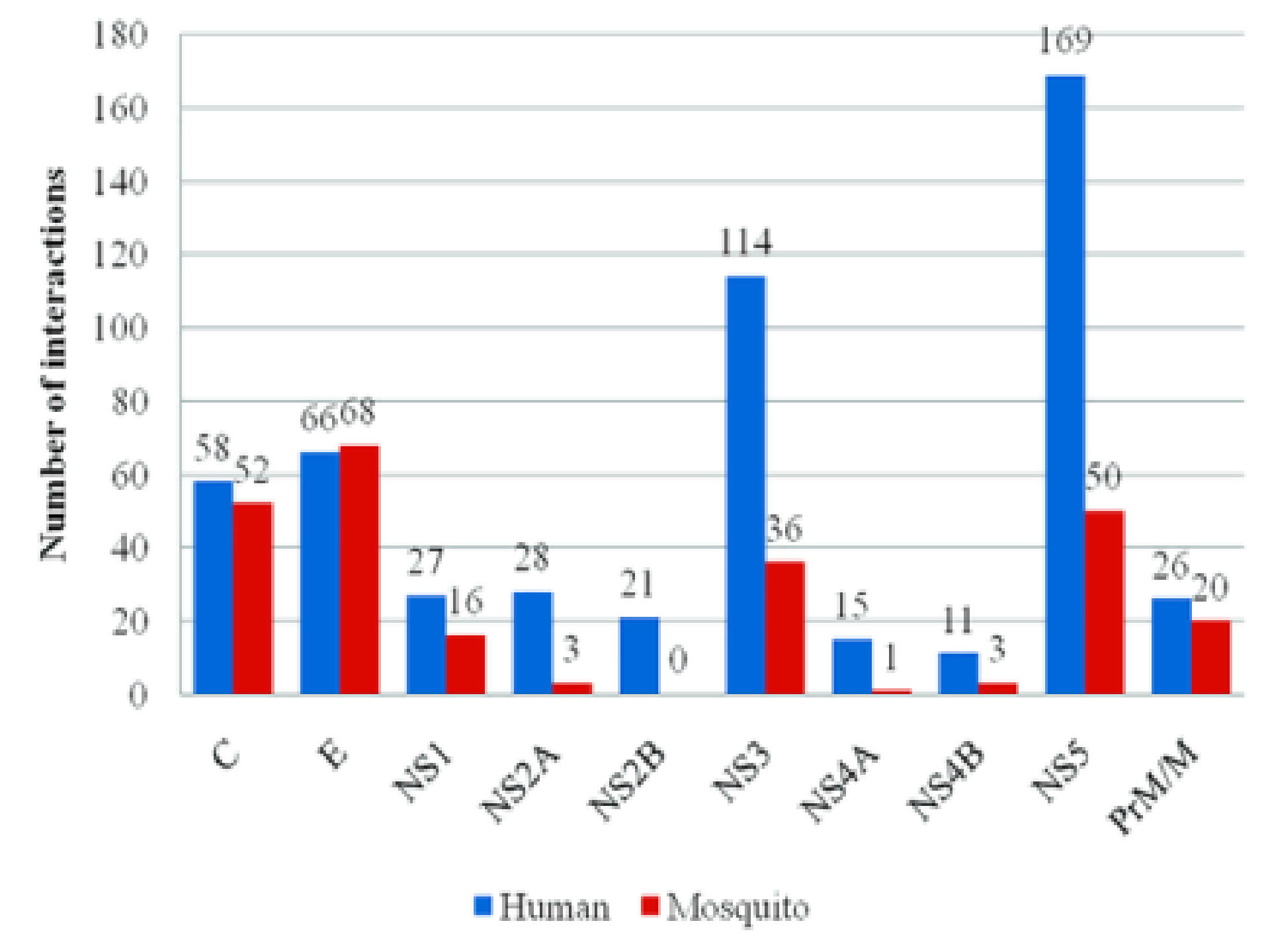
Component Specific Serotype Interaction



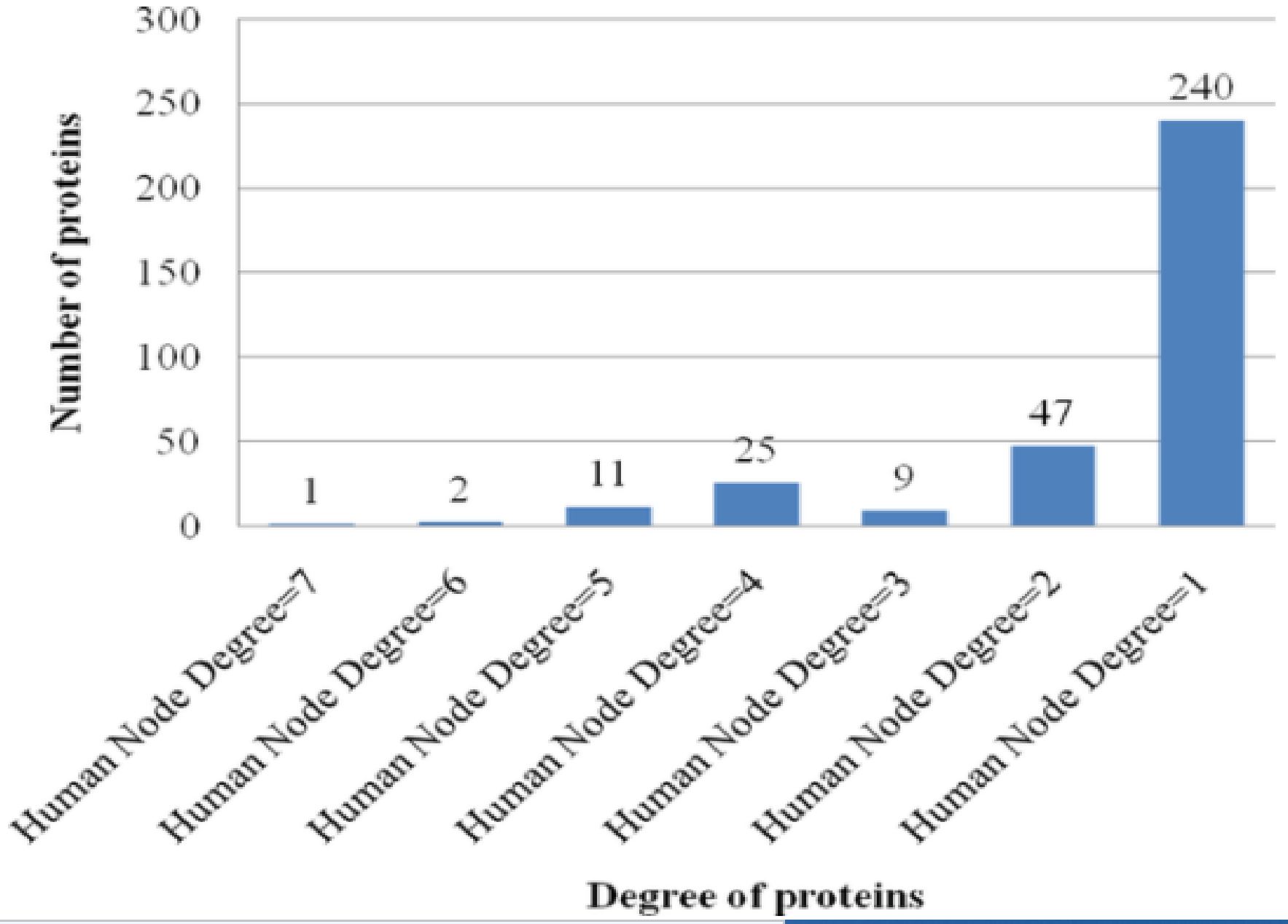
Recombinant dengue virus type 2 NS1 antigen is a purified preparation of the dengue virus serotype 2 (DENV2), non-structural protein 1 (NS1). DENV2 is one of four (DENV1-4) antigenically distinct, closely related viral serotypes belonging to the *Flaviviridae* family, genus flavivirus. All four serotypes are known to cause viral infection in humans.

Dengue virus is common mosquito-borne infection and a major cause of morbidity in tropical and subtropical regions. There is currently no vaccine to prevent, or effective anti-viral drugs to treat, dengue virus infection. In many cases infection is assymptomatic and the majority of individuals who get ill only suffer the mild, non-specific febrile symptoms characteristic of dengue fever (DF). Only a minority of infections result in severe disease, manifesting as dengue hemorrhagic fever (DHF) or dengue shock syndrome (DSS). Dengue virus infection gives lifelong immunity to the serotype in question but subsequent infection with another serotype may increase the likelihood of severe disease.

The NS1 glycoprotein is essential for viral replication and viability, and since this protein is secreted into the bloodstream, tests have been developed to diagnose DENV infections using NS1, including antigen-capture ELISA, lateral flow antigen detection, and the measurement of NS1-specific IgM and IgG responses (Guzman, M.G. *et al.*


Number of interactions
180
160
140
120
100
80
60
40
20
0
58
52
66
68
27
16
28
3
21
0
114
36
15
1
11
3
169
50
26
20
C
E
NS1
NS2A
NS2B
NS3
NS4A
NS4B
NS5
PrM/M
Human
Mosquito

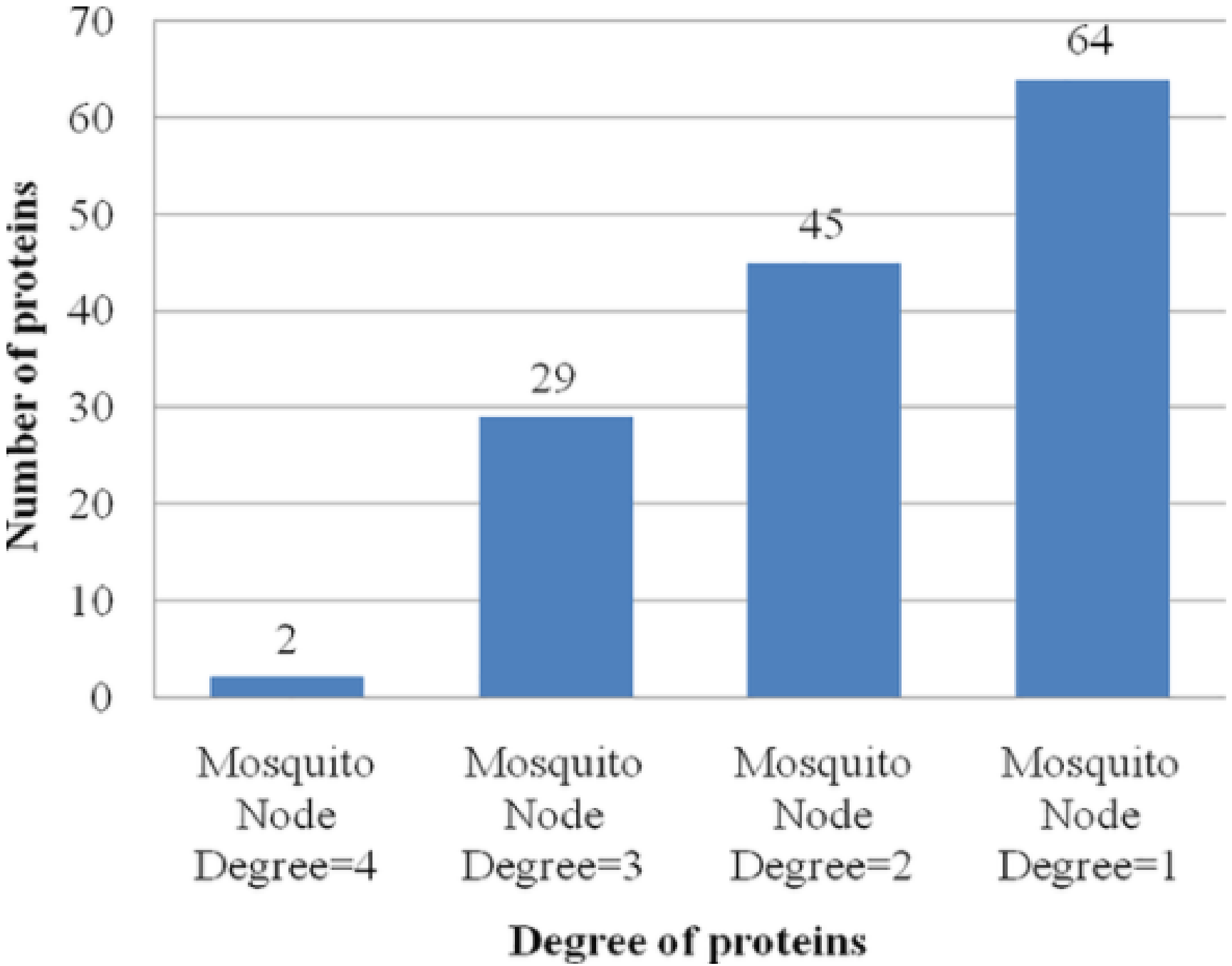
Testing Degree Of Interaction in Human Gene



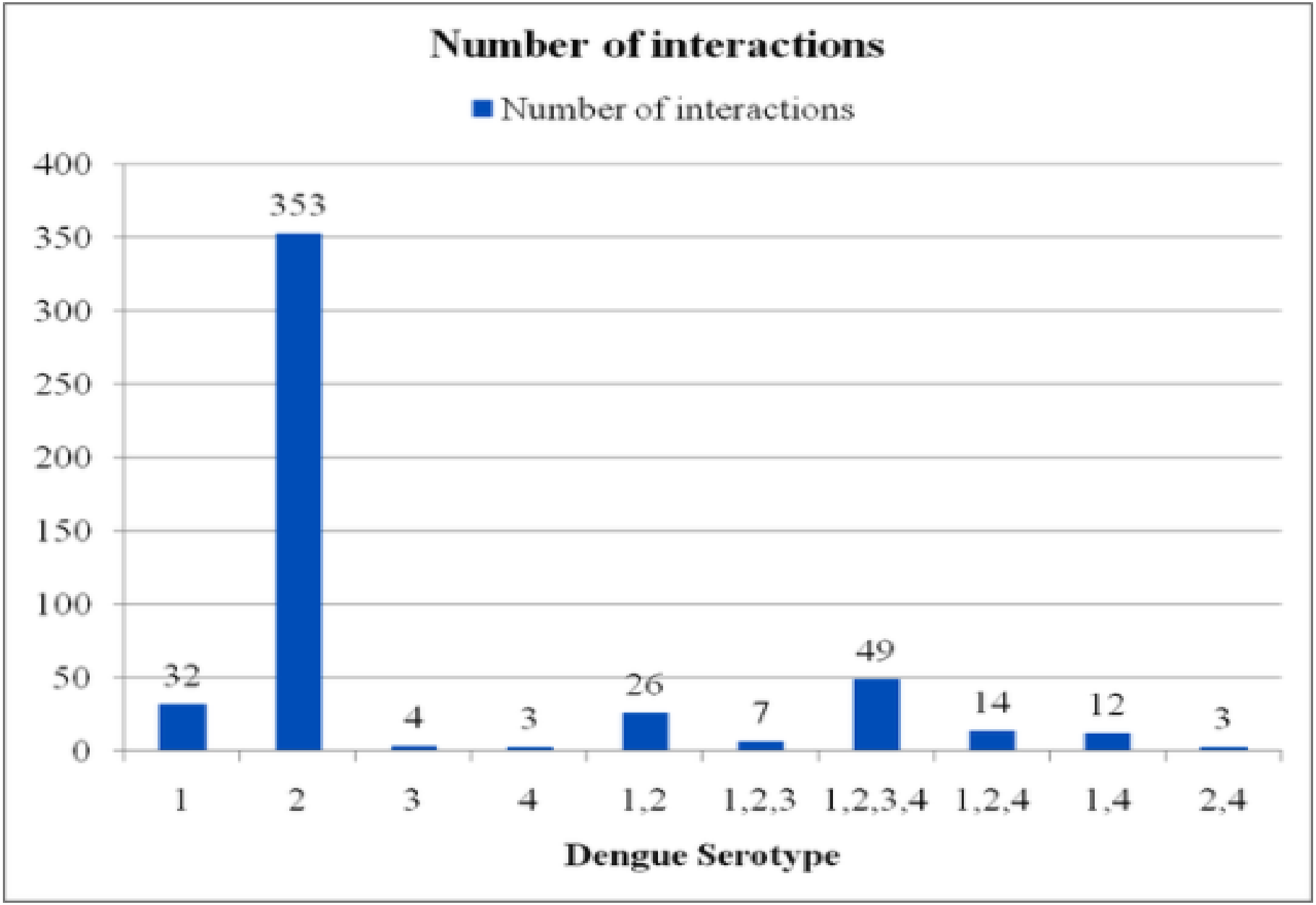
What is HBA1?

The *HBA1* gene provides instructions for making a protein called alpha-globin. This protein is also produced from a nearly identical gene called *HBA2*. These two alpha-globin genes are located close together in a region of chromosome 16 known as the alpha-globin locus.

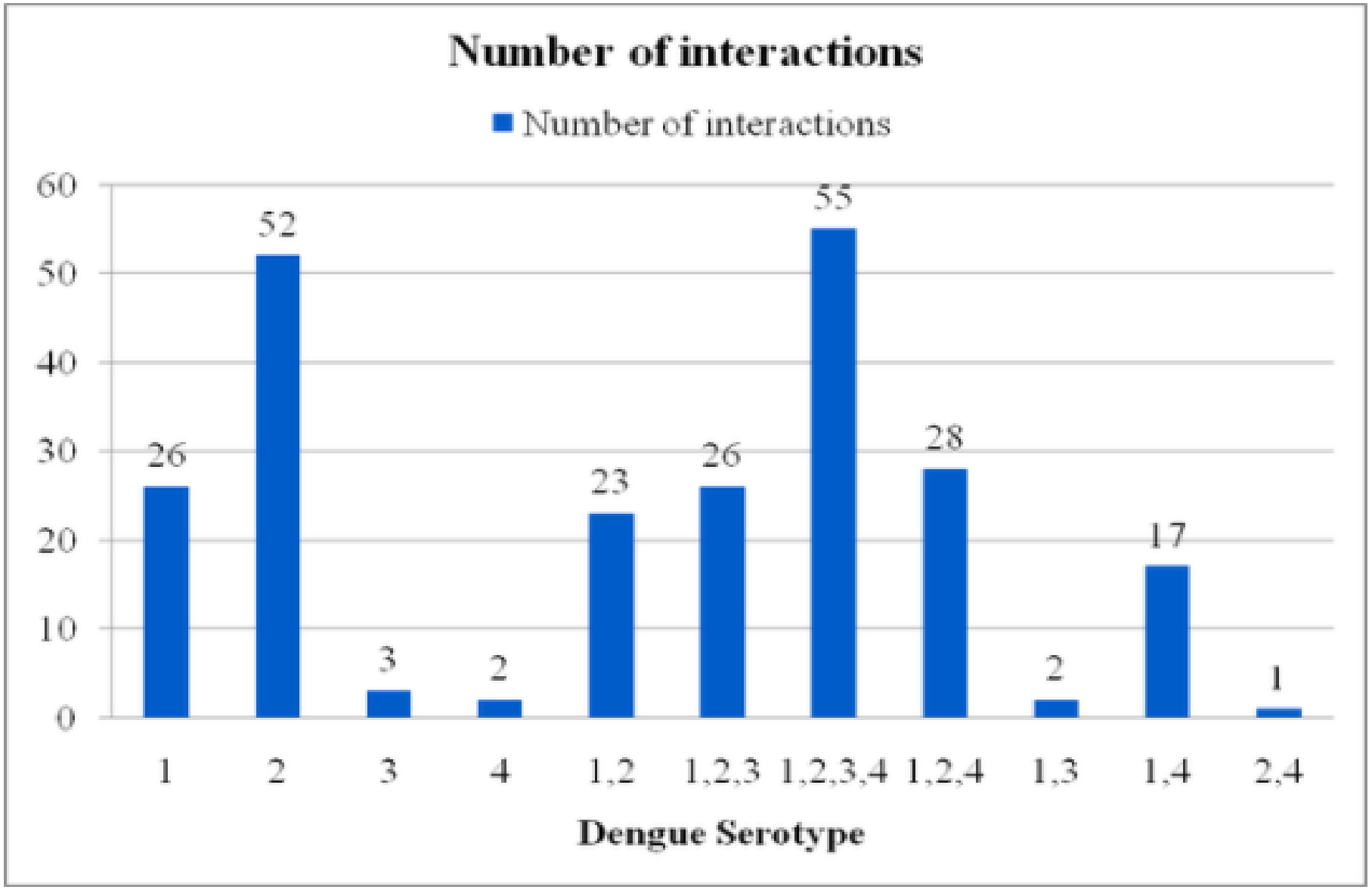
Alpha-globin is a component (subunit) of a larger protein called hemoglobin, which is the protein in red blood cells that carries oxygen to cells and tissues throughout the body. Hemoglobin is made up of four subunits: two subunits of alpha-globin and two subunits of another type of globin. Alpha-globin is a component of both fetal hemoglobin, which is active only before birth and in the newborn period, and adult hemoglobin, which is active throughout the rest of life.


70
60
50
40
30
20
10
0
Number of proteins
64
45
29
2
Mosquito Node Degree=4
Mosquito Node Degree=3
Mosquito Node Degree=2
Mosquito Node Degree=1
Degree of proteins

Dengue-Human Serotype Interaction



Dengue-Mosquito Serotype Interaction



Their Meal is your Disease. Stay Safe