

# **Can the Flu Vaccine Provide Additional Protection Against SARS-CoV 2?**

**By Mehaghni Chaudhury**

# Purpose

We are examining whether or not there is a protein sequence overlap between SARS-CoV-2 and influenza. To do so, we will be comparing the protein sequences of novel coronavirus and other common coronaviruses with antigen-generating sequences of the influenza virus.



# Background Information

- Influenza vaccine elicits blocking antibodies against hemagglutinin protein
- 
1. The Influenza vaccine is an inactivated viral vaccine
  2. The live attenuated virus elicits active immunity and produces blocking antibodies against hemagglutinin protein.
  3. Hemagglutinin viral protein is required for cell adhesion of viral particles, thus facilitating viral cellular entry of influenza virus

# Statement of the Problem

Due to the pending availability the the COVID-19 vaccine, can the flu vaccine provide additional protection against from COVID-19?



# Hypothesis

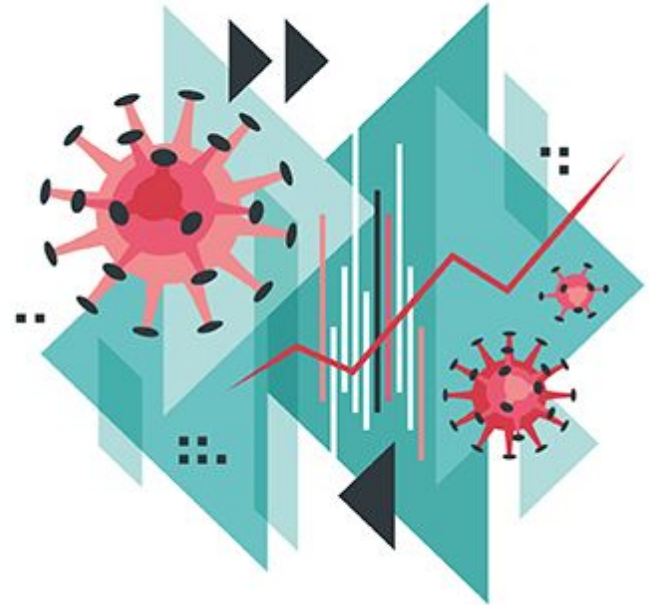
- Repurposing of influenza vaccine against SARS-CoV 2

I hypothesized that if there is peptide sequence overlap between hemagglutinin protein of influenza with surface glycoprotein or receptor protein of SARS-CoV2 novel coronavirus or any other proteins, then the blocking antibodies produced by influenza vaccination may offer additional protection against SARS-CoV 2 infection or SARS-CoV 2-Influenza infection



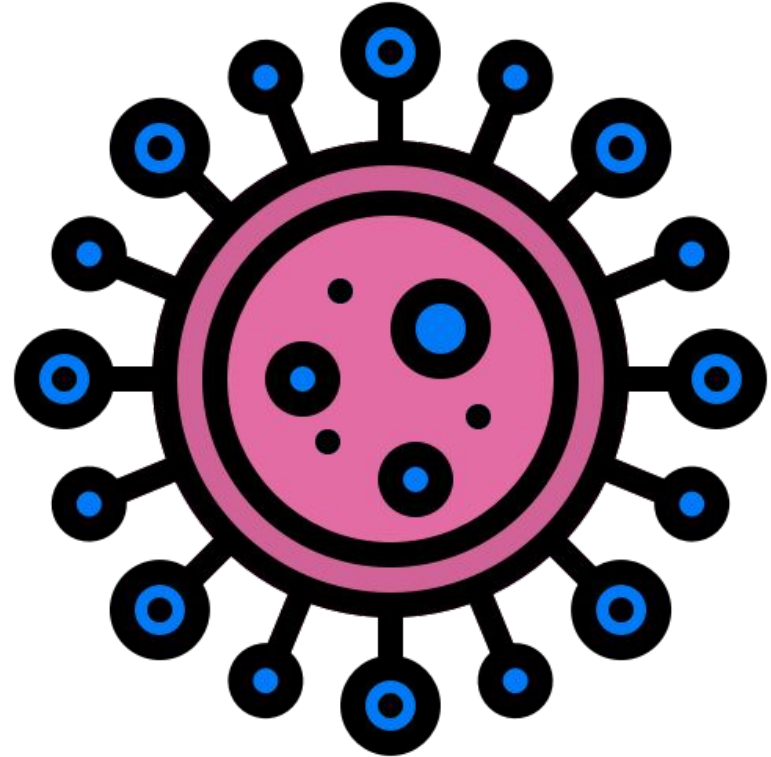
# Variables

- Control - pathogenic strains of influenza viruses and their key proteins
- Independent variable - Whether the genomic sequences overlap
- Dependant variable - Whether flu vaccine aides against COVID-19
- Constant - protein sequences



# Materials

- Genomic sequences of the flu and of COVID-19 (SARS-CoV-2)
- Different strains of COVID-19
- Different strains of influenza



# Methods

- **Methods of comparing protein sequences**
  - Protein sequences were obtained from NCBI protein
  - NCBI BLAST were used for comparison of protein sequences
  - Matching, if any were accessed after “blasting” the sequences



# Methods (cont.)

## Basic Local Alignment Search Tool

**BLAST** finds regions of similarity between biological sequences. The program compares nucleotide or protein sequences to sequence databases and calculates the statistical significance.

[Learn more](#)

NEWS

A new version BLAST+ (2.11.0) is here.

This version supports a new usage reporting service and a new multi-threading feature.

Tue, 05 Nov 2020 12:00:00 EST

[More BLAST news...](#)

## Web BLAST



## BLAST Genomes

Enter organism common name, scientific name, or tax id

Search

[Human](#)

[Mouse](#)

[Rat](#)

[Microbes](#)

## Standalone and API BLAST



Download BLAST

Get BLAST databases and executables



Use BLAST API

Call BLAST from your application



Use BLAST in the cloud

Start an instance at a cloud provider

# Methods (cont.)

Advanced

Help

COVID-19 is an emerging, rapidly evolving situation.  
Get the latest public health information from CDC: <https://www.cdc.gov/coronavirus>  
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GenPept

Send to:

Change region shown

Customize view

hemagglutinin, partial [Influenza A virus (A/Puerto Rico/8/1934(H1N1))]

GenBank: ADK95051.1

Identical Proteins Fasta Graphics

Go to

LOCUS

DEFINITION

ACCESSION

VERSION

DESCRIPTOR

KEYWORDS

SOURCE

ORGANISM

REFERENCE

AUTHORS

TITLE

JOURNAL

COMMENT

FEATURES

ORIGIN

ADK95051

344 aa

linear

VRL 25-JUL-2015

hemagglutinin, partial [Influenza A virus (A/Puerto Rico/8/1934(H1N1))].

ADK95051

ADK95051.1

accession: [HQ008261.1](#)

Influenza A virus (A/Puerto Rico/8/1934(H1N1))  
Influenza A virus (A/Puerto Rico/8/1934(H1N1))  
Viruses; Riboviria; Orthornavirae; Negarnaviricota;  
Polyploviricotina; Insthoviricetes; Articulavirales;  
Orthomyxoviridae; Alphainfluenzavirus.

1 (residues 1 to 344)

Komadina, N. and Deng, Y.-M.

Submitted (02-AUG-2010) Reference and Research on Influenza, WHO  
Collaborating Centre for Reference and Research on Influenza, 18  
Wreckyn Street, North Melbourne, Victoria 3051, Australia

Method: conceptual translation.

Location/Qualifiers

1..344

/organism="Influenza A virus (A/Puerto Rico/8/1934(H1N1))"

/strain="A/Puerto Rico/8/1934"

/serotype="H1N1"

/host="Homo sapiens"

/db\_xref="taxon:215044"

/segment="4"

/country="Puerto Rico"

/collection\_date="1934"

1..344

/product="hemagglutinin"

28..343

/region name="Hemagglutinin"

/note="Hemagglutinin; pfam00500"

/db\_xref="CCD:278018"

1..344

/gene="HA"

/coded\_by="HQ008261.1:1..1032"

1 mkaillvllc alaamadti clyghannst dtdvdlvlen vtvthsnvll edshgklcr  
61 lkgiaplqlg krdiapellg spcdpllpv rswsylvetp nsengicypg dfidyevlre  
121 qlssvssfer felpkssaw pbrntngvta acshgkssf ymllwlttek egspyklns  
181 ymkgkqvll vlaglfhpgp sksqqlqys enayvsvvts nymreftpel aarpkvrda  
241 gresywtll kpgdtllfva ngliapmya fslngfgsg lltssasme cntkcpqlg  
301 alnslpypqn lhpvtlgcp kyvssaklrn vtglmipsi qng

//

Analyze this sequence

Run BLAST

Identify Conserved Domains

Highlight Sequence Features

Find in this Sequence

Influenza Virus Resource

Retrieve, view, and download influenza virus  
genomic and protein sequences.

Related Information

Nucleotide

Taxonomy

CCD Search Results

Conserved Domains (Condse)

Conserved Domains (Full)

Encoding mRNA

Related Structures (List)

Related Structures (Summary)

LinkOut to external resources

Influenza Research Database  
[\[Influenza Research Database\]](#)

Recent activity

hmagglutinin, partial [Influenza A virus  
(A/Puerto Rico/8/1934(H1N1))] Protein

hmagglutinin, partial [Influenza A virus  
(A/Kenya/685/2015(H3N2))] Protein

PSI-BLAST Tutorial - Comparative  
Genomics

hypothetical protein GSP52\_15210, partial  
[Enterococcus mundii] Protein

hemagglutinin (417846) Protein

See more...

# Methods (cont.)

NCBI Resources How To Sign in to NCBI

Protein   Help

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FASTA

**hemagglutinin, partial [Influenza A virus (A/Puerto Rico/8/1934(H1N1))]**

GenBank: ADK95051.1

[GenPept](#) [Identical Proteins](#) [Graphics](#)

>ADK95051.1 hemagglutinin, partial [Influenza A virus (A/Puerto Rico/8/1934(H1N1))]  
MKAKLLVLLCALAAADATICIGYHANNSTDTVDTVLEKNVTVTHSVNLLDSDHNGKLCRLKGIAPLQLG  
KCNIAQMLLGNPECDPLLPVRSMYSIVETPNSNGICYPGDFIDYEELREQLSSVSSFERFEIFPKESM  
PNNHTNGVTAACSHEGKSSFYRNLLMLTEKESYFKLKNSSVNNKKGKVLVLWGDHHYNNKSEQQNLVON  
ENAYSVSVTSNYYRRFTPEIAERPKVRDQAGRNNYYWTLKPGDTIIFEANGNLIAPMYAFALSNGFGSG  
IITSNASMHCNTKQITPLGADNSSLPQNDHPVTIGEDPKYVRSKLRNMTGLRNLPSTQSRG

Analyze this sequence

Identify Conserved Domains

Highlight Sequence Features

Find in this Sequence

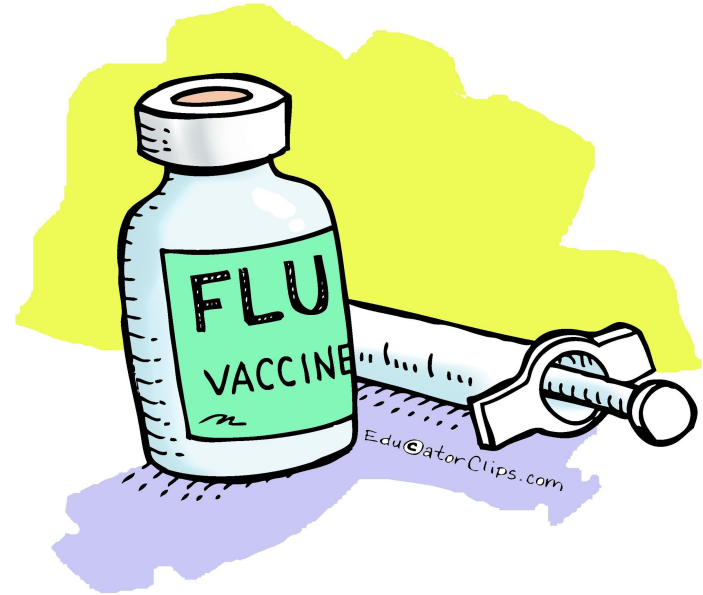
Influenza Virus Resource

# Methods (cont.)

- Examined proteins of the Influenza virus
  - Mainly hemagglutinin of Influenza A was examined
  - Hemagglutinin of other influenza strains covering both the northern and southern hemisphere were examined.
  - Further other influenza proteins like neuraminidases were additionally examined

# Methods (cont.)

- Protein sequences of SARS-CoV2 were used for comparison
- Surface glycoprotein
- 3 to 5 exonuclease
- Non Structural Protein(NSP)
- 2-O ribose methyltransferase
- RNA dependent RNA Polymerase
- 3-C like Proteinases
- Membrane glycol protein
- Envelope protein
- Surface Glycoprotein
- Open reading frame(ORF)



# Methods (cont.)

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U.S. National Library of Medicine

NCBI National Center for Biotechnology Information

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Align Sequences Protein BLAST

blastnblastblastxblastnblastx

BLASTP programs search protein subjects using a protein query. [more...](#)

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Enter Query Sequence

Enter accession number(s), gi(s), or FASTA sequence(s)

Clear

Query subrange

From

To

Or, upload file

Choose FileNo file chosen

Job Title

Enter a descriptive title for your BLAST search

☒ Align two or more sequences

Enter Subject Sequence

Enter accession number(s), gi(s), or FASTA sequence(s)

Clear

Subject subrange

From

To

Or, upload file

Choose FileNo file chosen

Program Selection

Algorithm

☒ blastp (protein-protein BLAST)  
Choose a BLAST algorithm


BLAST

Search using Blastp (protein-protein BLAST)  
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# Methods (cont.)

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Align Sequences Protein BLAST

blastnblastpblasttblastntblastx

BLASTP program search protein subjects using a protein query. [more...](#)

Reset pageBookmark

Enter Query Sequence

Enter accession number(s), gi(s), or FASTA sequence(s)

Influenza Protein

ClearQuery subrange

From

To

Or, upload file

Choose FileNo file chosen

Job Title

Enter a descriptive title for your BLAST search

☒ Align two or more sequences

Enter Subject Sequence

Enter accession number(s), gi(s), or FASTA sequence(s)

SARS-CoV 2 protein

ClearSubject subrange

From

To

Or, upload file

Choose FileNo file chosen

Program Selection

Algorithm

@ blastp (protein-protein BLAST)

Choose a BLAST algorithm


BLAST

Search using Blastp (protein-protein BLAST)

☐ Show results in a new window

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# Results

- Upon repeated comparison by blasting, not enough similarity was found between any two protein sequences.

(Pictures of results continued on next slide)



# Results (cont.)

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Find NCBI SARS-CoV-2 literature, sequence, and clinical content: <https://www.ncbi.nlm.nih.gov/sars-cov-2/>.

BLAST<sup>®</sup> » blastp suite-2sequences » results for RID-V36SM6PA114

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**Job Title** Protein Sequence

**RID** [V36SM6PA114](#) Search expires on 11-17 04:18 am [Download All ▼](#)

**Program** Blast 2 sequences [Citation ▼](#)

**Query ID** Ict|Query\_35977 (amino acid)

**Query Descr** None

**Query Length** 470

**Subject ID** Ict|Query\_35979 (amino acid)

**Subject Descr** None

**Subject Length** 1273

**How to read this report?** [BLAST Help Videos](#) [Back to Traditional Results Page](#)

**Filter Results**







**Percent Identity**  to


**E value**  to

**Query Coverage**  to

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**A** No significant similarity found. For reasons why, [click here](#)

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# Conclusion

- There is minimum to no overlap in protein sequences of multiple proteins of SARS-CoV 2 with hemagglutinin or other proteins of major strength of Influenza A virus
- This indicated that influenza A virus and SARS-CoV 2 Virus are evolutionarily different
- Further detailed analysis are required to obtain more specific information whether shorter sequences of peptides overlap, we plan to use multiple sequence alignment tools like Clustal.
- However increasing epidemic intelligence is showing influenza A co infection alongside SAR-Cov 2 infection, whether Influenza A worsens the outcome of SARS-CoV 2 infection currently unknown.
- Nevertheless Influenza vaccination is highly protective as influenza is a major morbid and mortal illness across the globe.

