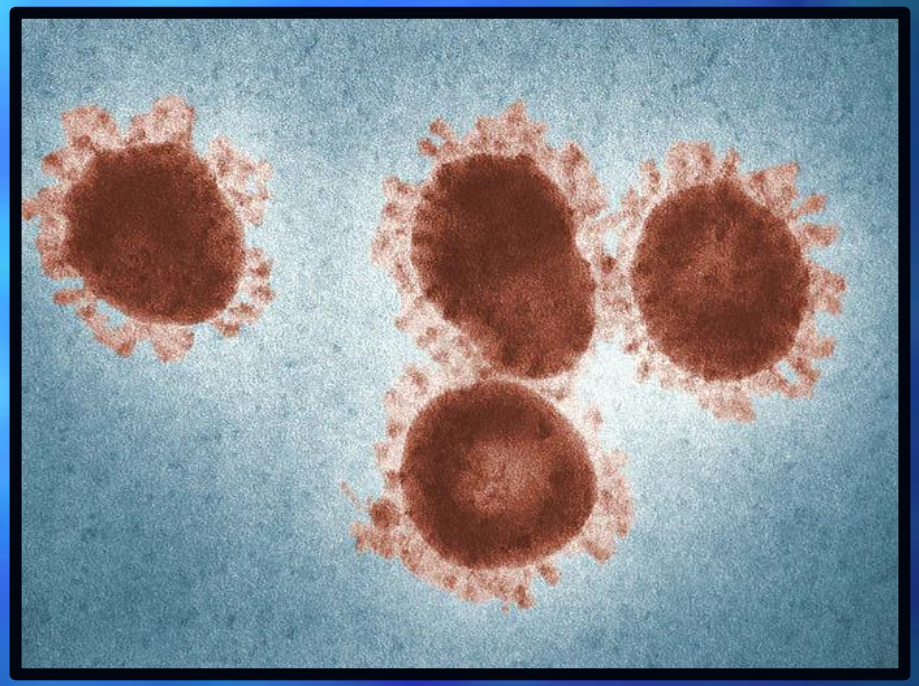
Ministering to the Community in a Time of Crisis



The Threat of RNA Viruses

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- These PowerPoint Presentations are written and provided to prepare the Body of Christ for disasters such as the current pandemic
- These trainings are meant to enable people to safely care for themselves and minister to their neighbors
- By being properly equipped we are then able to bring the gospel of our Lord, Jesus Christ into the situation
- For more information, please visit outrunningthehorses.com

The Threat of RNA Viruses

- Viruses that carry RNA mutate much faster than a DNA virus
  - Up to 1 million times faster
- Influenza and Corona viruses are among those that mutate the fastest

- Viruses that carry RNA mutate much faster than a DNA virus
  - Up to 1 million times faster
- Influenza and Corona viruses are among those that mutate the fastest

The Threat of RNA Viruses

- To first identify the structural parts of a virus and what role they play in the course of human infection will help in understanding the risk of mutations
- This presentation will use the influenza virus as a model of what happens in the world of viruses

The Threat of RNA Viruses

- Some viruses that contain RNA as their nucleotide material for replication include:
  - Influenza (Seasonal, Bird Flu, H1N1, etc.)
  - Coronavirus (COVID-19, SARS, MERS, etc)
  - Ebola
  - Nepah
  - Rabies
  - Polio

The Threat of RNA Viruses Objectives

- The following topics will be discussed
  - Influenza Viruses overview
    - Protein Antigen Surface
      - –Hemagglutinins
      - –Neuraminidases
      - –Mutation

The Threat of RNA Viruses Objectives

- The following topics will be discussed
  - Coronaviruses overview
    - Four structural proteins,
      - Nucleocapsid (N)
      - Membrane (M)
      - Spike (S)
      - Envelop (E) and several non-structural proteins

The Threat of RNA Viruses Objectives

- Significance of DNA vs. RNA
  - Mutation
    - Antigenic Drift
    - Antigenic Shift
    - Genetic Reassortment

The Threat of RNA Viruses
Influenza

- Influenza – Italian (*un influenza di freddo)*
  "To be influenced by the stars"
- Also known as seasonal flu
  - Highly contagious
  - Occurs in colder less humid months
    - Fall through January or February (as late as May)
  - Mainly affects the upper respiratory tract

The Threat of RNA Viruses Influenza

- Influenza member of orthomyxoviruses
  - Family of RNA viruses
  - Classified by nucleoprotein antigen
  - Three types that infect vertebrates
    - Influenza A – humans, other mammals, birds
    - Influenza B – humans, seals
    - Influenza C – humans, pigs

The Threat of RNA Viruses Influenza

- Seasonal influenza caused by Type A or B
  - Most people have some immunity to circulating strains
  - Severity of illness substantially less than during pandemics
  - Trivalent vaccine prepared each year (two type A and one type B)

The Threat of RNA Viruses Protein Antigen Surface

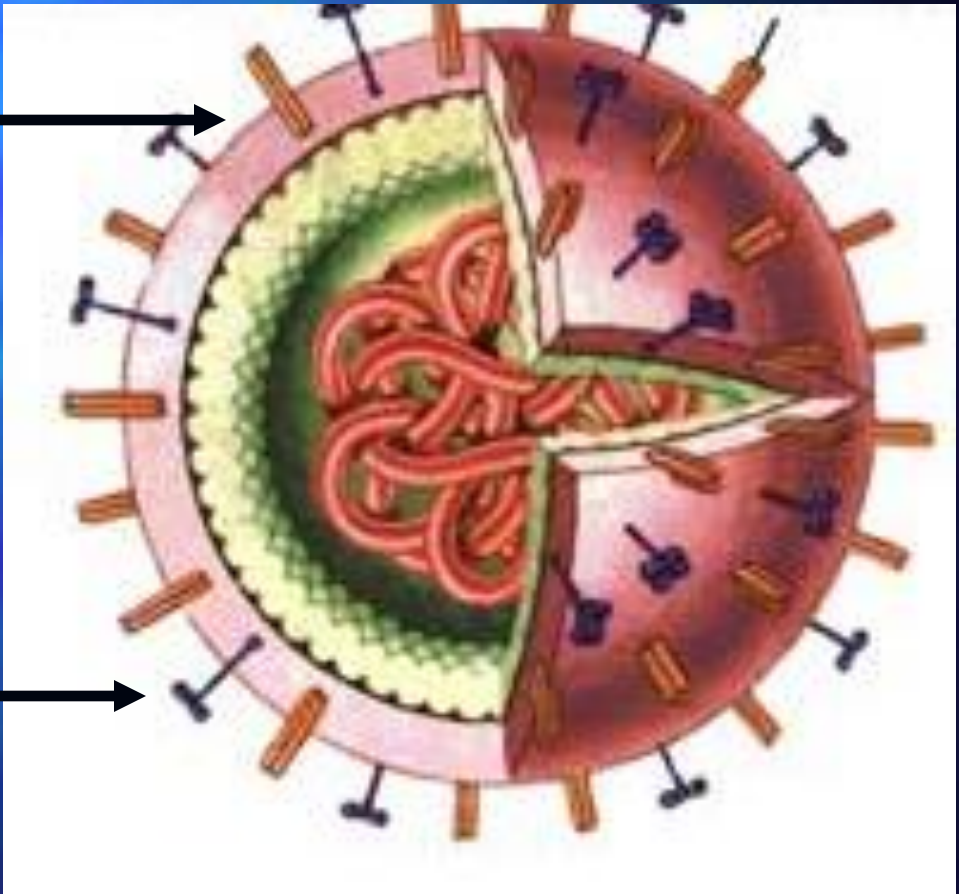
The Threat of RNA Viruses Protein Antigen Surface

- Protein antigens on surface called Hemagglutinin (H) and Neuraminidase (N)
  - Enable the virus to attach and invade host cells
  - Undergo genetic variations (mutations)
  - Immune system recognizes these antigens
    - By this recognition people build immunity
    - By mutations people become re-infected

The Threat of RNA Viruses
Protein Antigen Surface

Hemagglutinin (H)

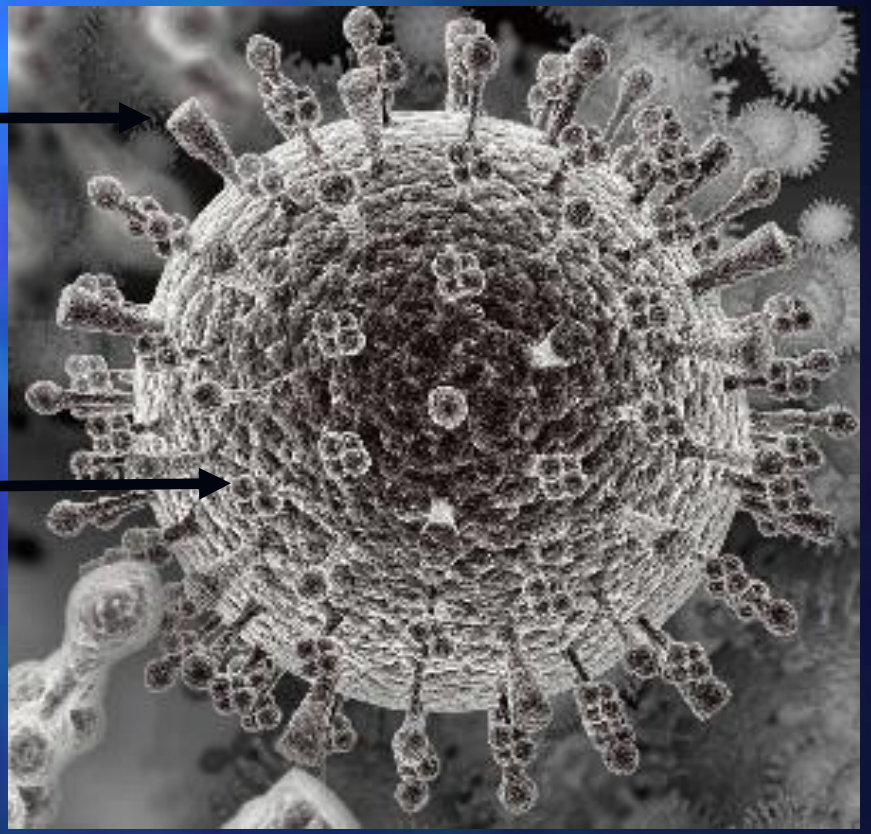
Neuraminidase (N)



The Threat of RNA Viruses
Protein Antigen Surface

Hemagglutinin
(H)

Neuraminidase
(N)



The Threat of RNA Viruses Protein Antigen Surface

- Hemagglutinin
  - Considered to be the "key"
  - By the hemagglutinin's shape the virus can attach and penetrate specific receptors on host cells
  - Glycogen receptors in respiratory system especially susceptible to these proteins

The Threat of RNA Viruses Protein Antigen Surface

- Neuraminidase
  - Considered to be the "scalpel"
  - Under an electron microscope, at top of each N, it appears that there are propellers similar to a helicopter

The Threat of RNA Viruses Protein Antigen Surface

- Neuraminidase
  - Blades allow Ns to destroy sialic acid in mucus enabling hemagglutinin to bind to receptor
  - "Blades" prohibit sialic acid from binding to viruses when they burst from cell
  - This ensures new viruses can break free to infect new host cells

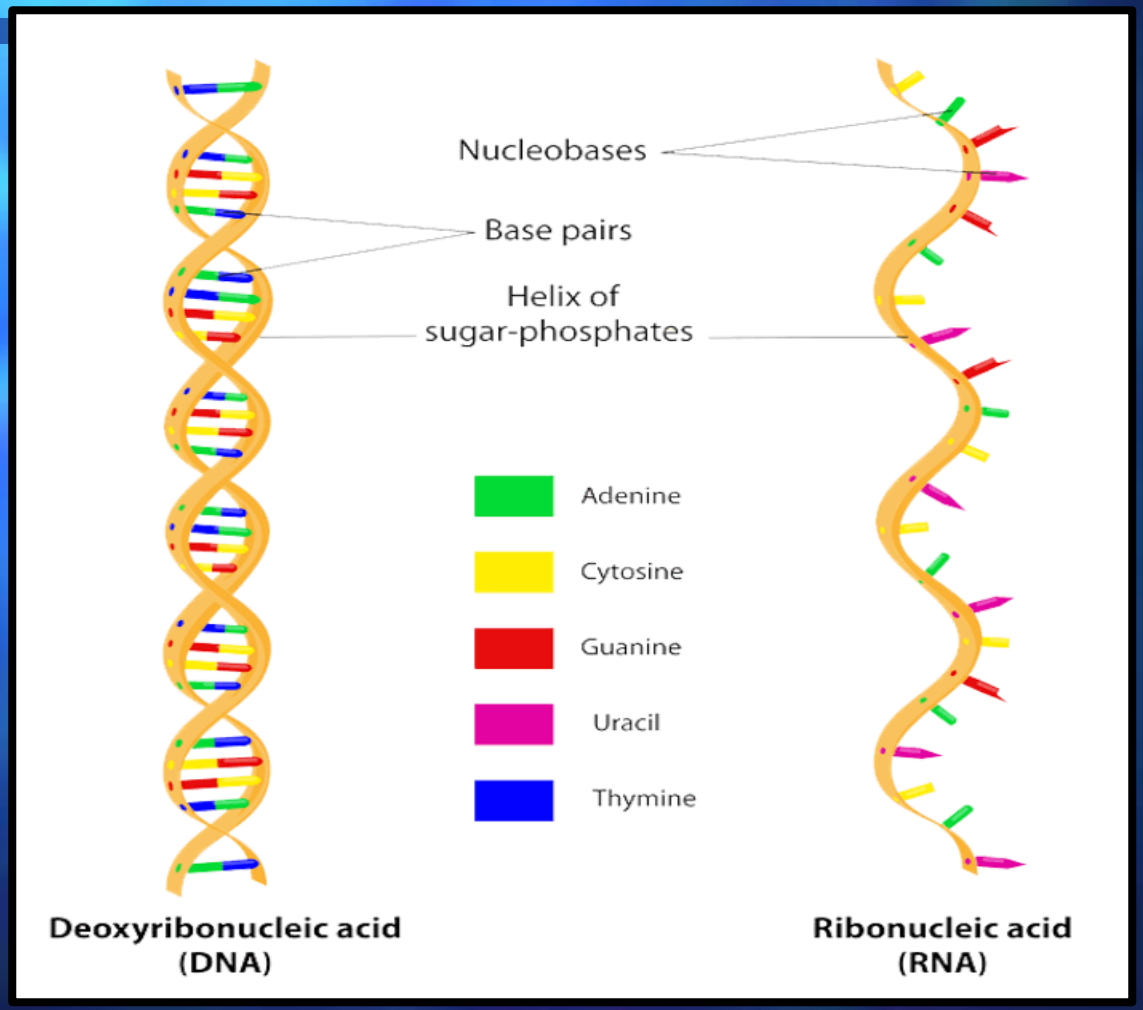
The Threat of RNA Viruses Protein Antigen Surface

- Subtypes of the Influenza A virus are categorized by these proteins (H1N1, H5N1, H7N9, etc..)
  - Hemagglutinin (H)
    - 18 subtypes
  - Neuraminidase (N)
    - 11 subtypes

The Threat of RNA Viruses Protein Antigen Surface

- Type A viruses frequently mutate
- Combinations of these protein subtypes lead to various strains
  - (H1N1, H5N1, H7N9, H5N2, etc...)
- Few people have immunity
- How pandemics emerge

The Threat of RNA Viruses
Significance of DNA vs. RNA



The Threat of RNA Viruses Significance of DNA vs. RNA

- Nucleic acid contains genetic material
  - In most life forms it is made of Deoxyribonucleic Acid (DNA)
  - Holds genetic instructions used in development and functioning of all known living organisms
  - Like the blueprints for a building
- Influenza viruses contain Ribonucleic Acid (RNA)

The Threat of RNA Viruses Significance of DNA vs. RNA

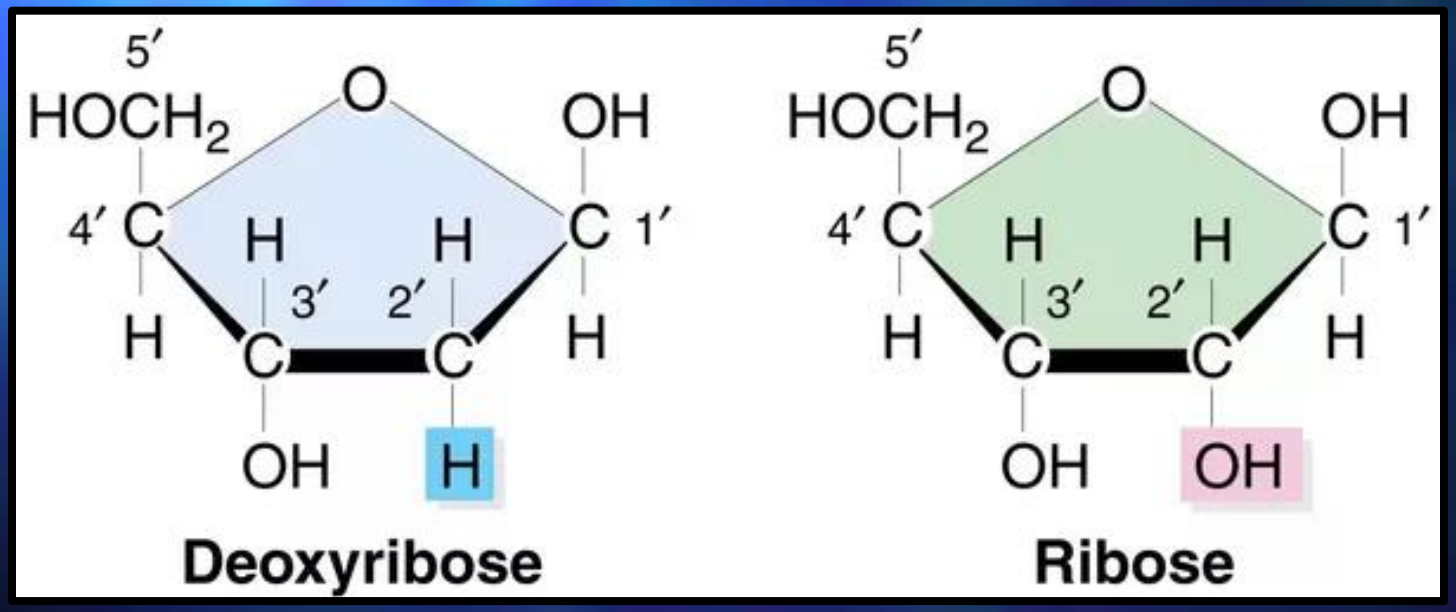
- DNA (Deoxyribonucleic Acid)
  - Double strand
  - "Deoxy" means there are no hydroxyl groups (-OH)
  - Absence of hydroxyl groups means chemical bonds are not easily broken down into water (H2O)

The Threat of RNA Viruses Significance of DNA vs. RNA

- DNA is completely protected by the body
  - The body destroys enzymes that attach to DNA
  - DNA has smaller grooves where the damaging enzyme can attach which makes it harder for the enzyme to attack DNA
  - Has a built-in proof-reading system when reproducing itself

The Threat of RNA Viruses Significance of DNA vs. RNA

- Deoxyribose sugar in DNA is less reactive because of C-H bonds
- Stable in alkaline conditions



The Threat of RNA Viruses Significance of DNA vs. RNA

- RNA
  - Single strand
  - Contains hydroxyl groups
    - Chemical bonds are easily broken into water (H2O) called hydrolysis
      - –More fragile
      - –Strands are easily broken

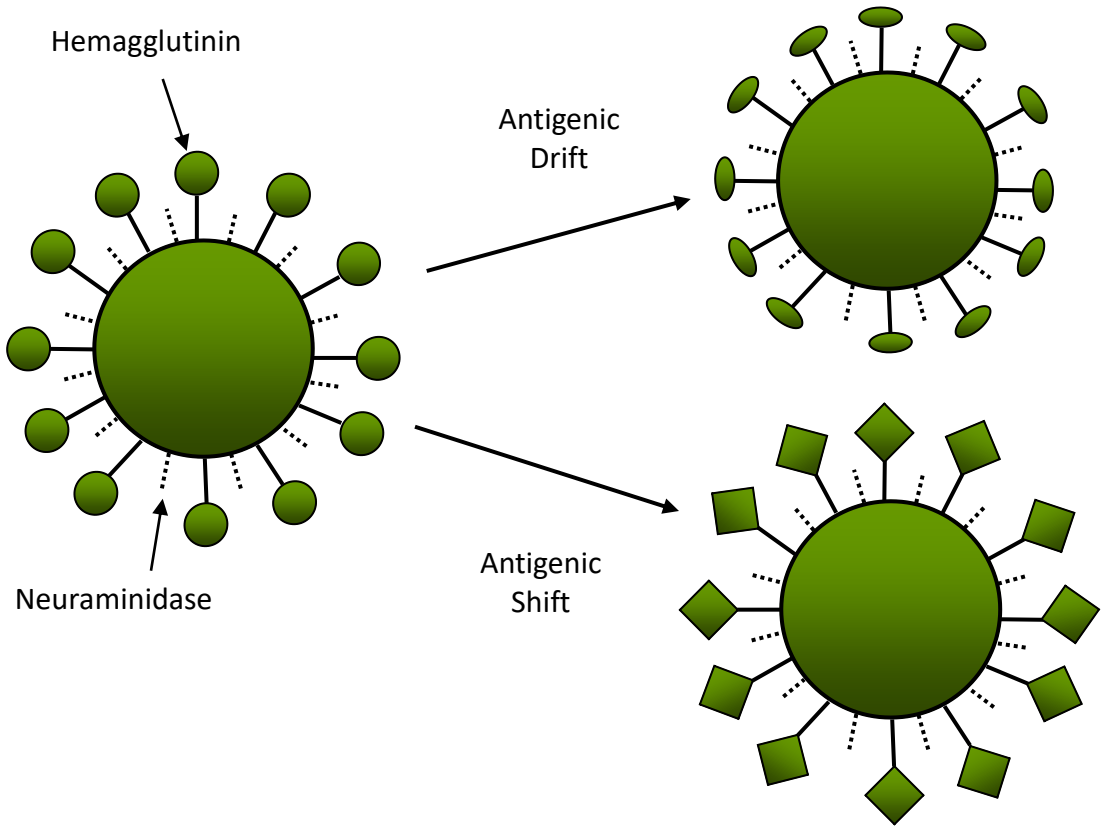
The Threat of RNA Viruses Significance of DNA vs. RNA

- Ribose sugar is more reactive because of OH (hydroxyl) bonds
- Not stable in alkaline conditions
- Has larger grooves which makes it easier to be attacked by enzymes

The Threat of RNA Viruses Significance of DNA vs. RNA

- RNA
  - Contains no proof-reading system
    - Mistakes happen called mutations
    - One virus can produce many variations of itself
    - RNA viruses can mutate up to 1 million times faster than DNA viruses

The Threat of RNA Viruses
Mutation – Antigenic Drift and Shift



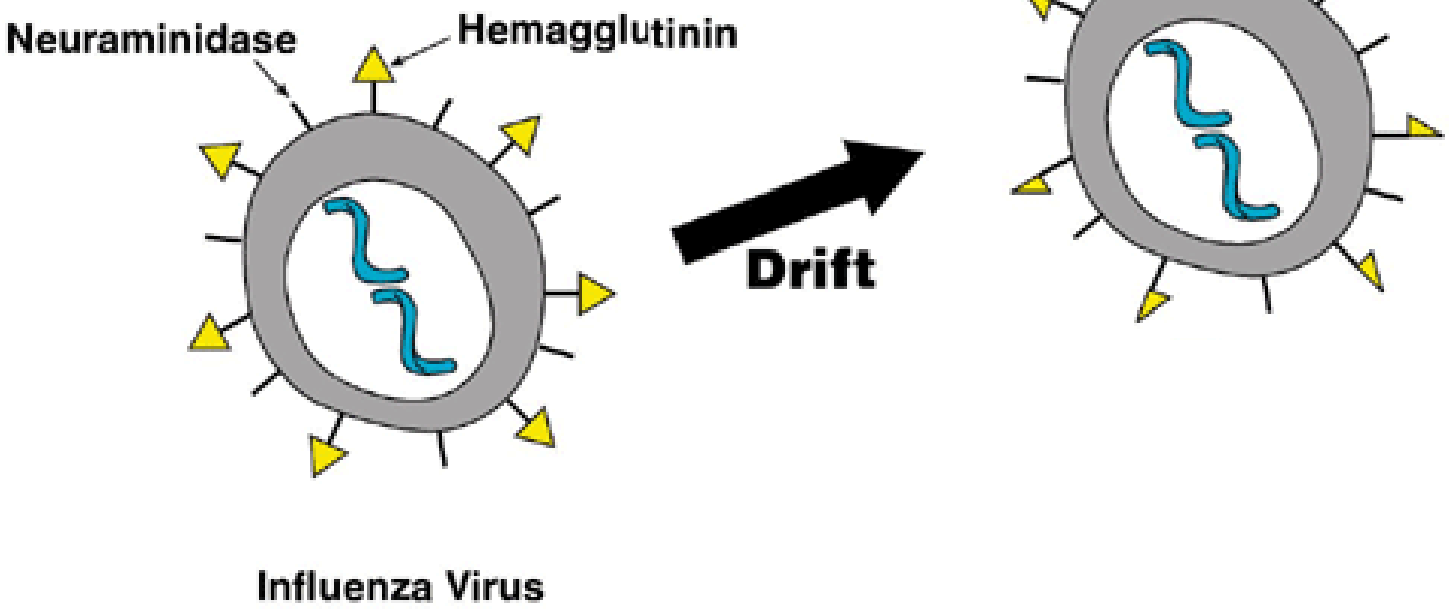
The Threat of RNA Viruses
Mutation – Antigenic Drift and Shift

- Changes in a virus happen continually over time
- Produces new strains not recognized by the host's immune system
- Known as Antigenic Shift or Drift

The Threat of RNA Viruses
Mutation – Antigenic Drift and Shift

- Antigenic Drift
  - Small changes over time newer virus strains appear
  - Antibodies against older strains no longer recognize the "newer" virus
  - Reinfection can occur
    - People can get the flu more than once

The Threat of RNA Viruses
Mutation – Antigenic Drift and Shift



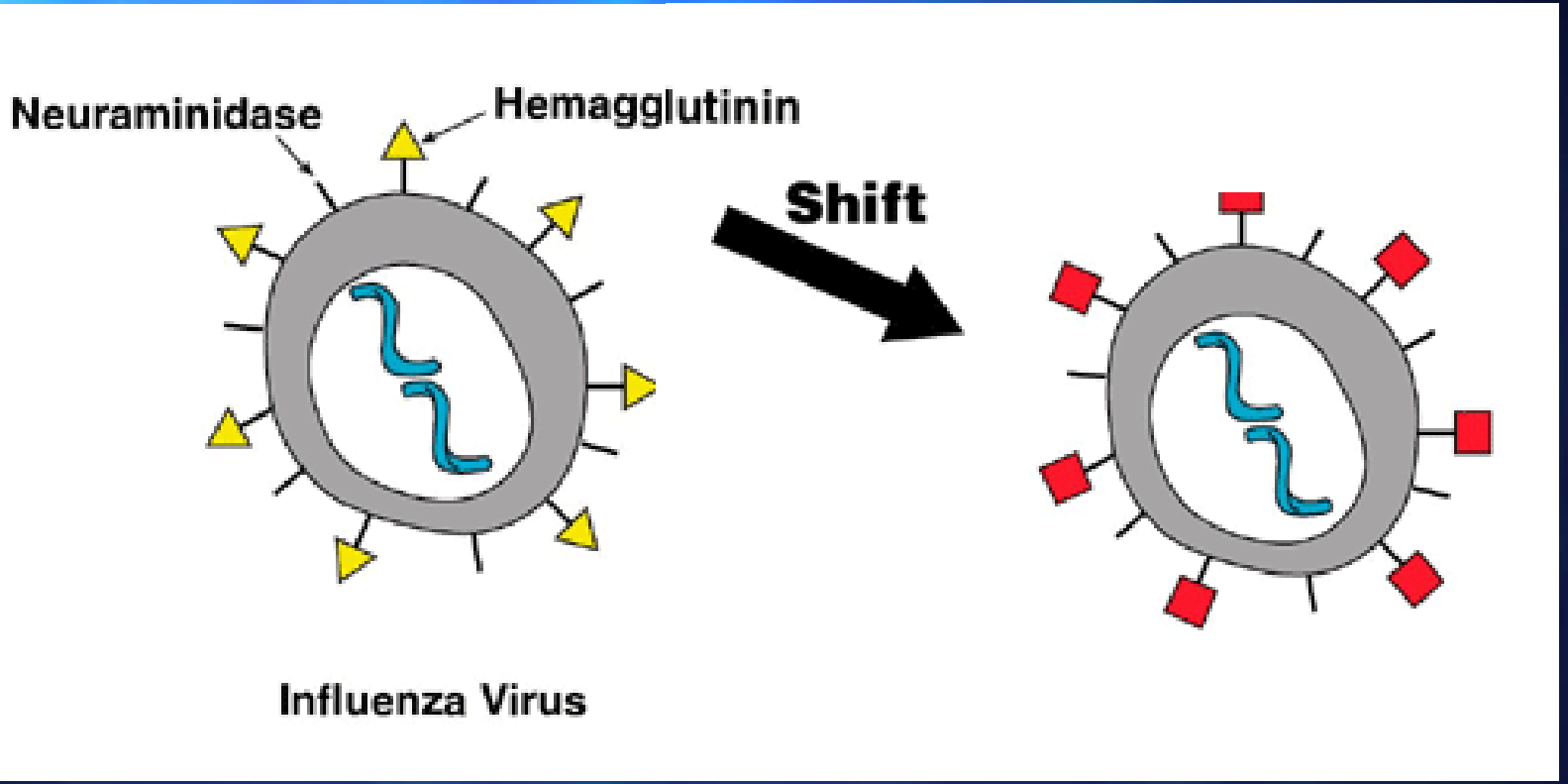
The Threat of RNA Viruses
Mutation – Antigenic Drift and Shift

- Influenza vaccines are updated to keep up with circulating flu viruses
- People who want to be protected need to get a flu shot every year

The Threat of RNA Viruses
Mutation – Antigenic Drift and Shift

- Antigenic Shift
  - An abrupt, major change results in new H or H and N proteins
  - Most people have little or no protection
  - Leads to influenza epidemics/ pandemics

The Threat of RNA Viruses
Mutation – Antigenic Drift and Shift



The Threat of RNA Viruses
Mutation – Antigenic Drift and Shift

- Antigenic Drift in Influenza viruses happens all the time
- Antigenic Shift happens only occasionally

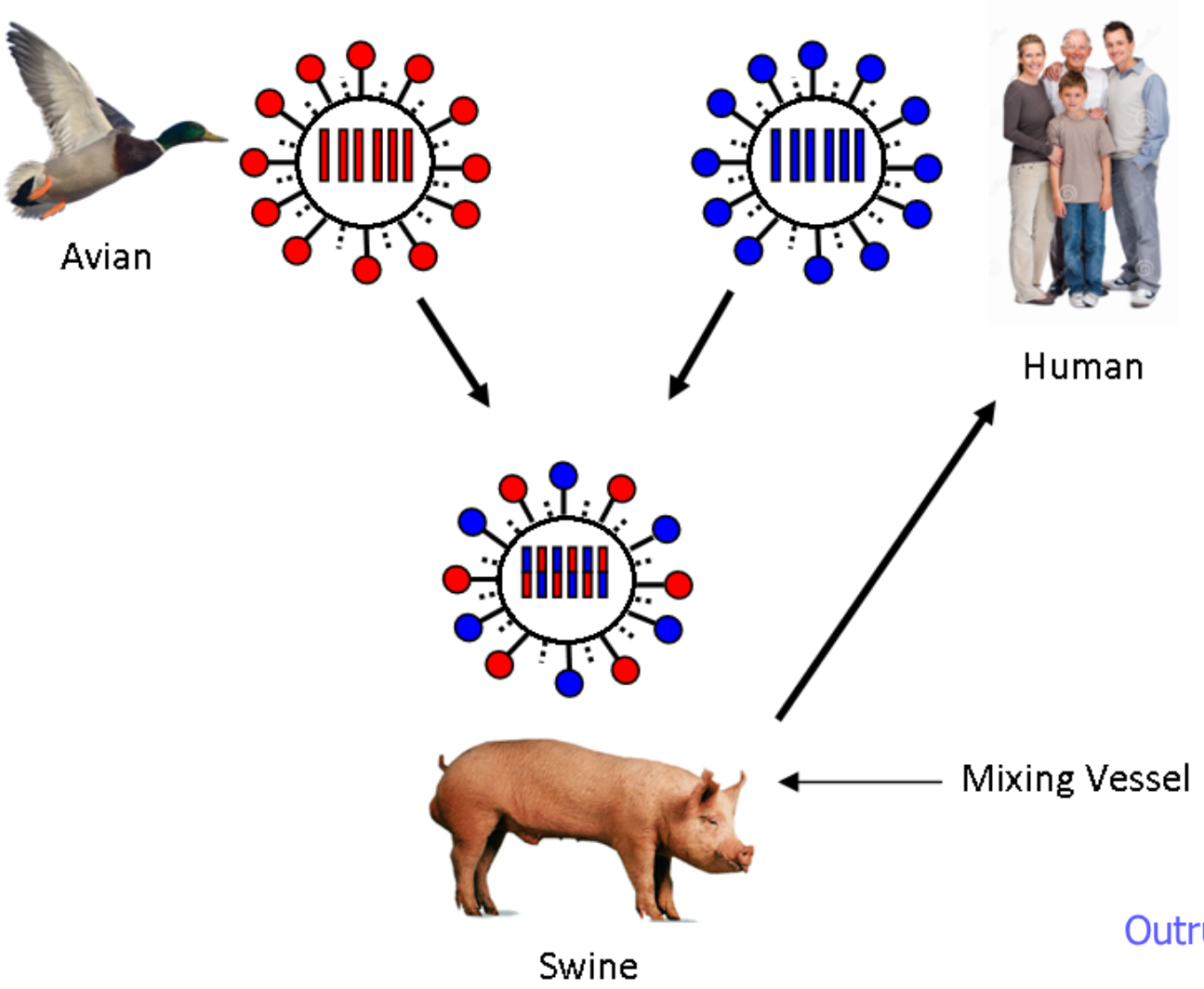
The Threat of RNA Viruses Mutation – Genetic Reassortment

- Genetic Reassortment
  - Influenza viruses from different species can swap or reassort genetic material
  - Results in a new subtype different from both parent viruses

The Threat of RNA Viruses Mutation – Genetic Reassortment

- Pigs susceptible to infection from both bird and human viruses
  - Serve as a "Mixing Vessel" of genetic material
  - Can result in a new viral subtype

The Threat of RNA Viruses
Mutation – Genetic Reassortment



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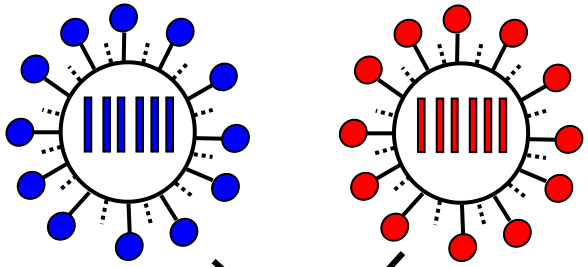
The Threat of RNA Viruses Mutation – Genetic Reassortment

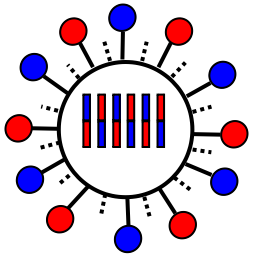
- Humans can also serve as mixing vessel
  - Avian mixed with human virus can result in antigenic shift
  - Result in a deadly transmissible person to person virus

The Threat of RNA Viruses
Mutation – Genetic Reassortment

Highly Pathogenic
Avian Strain



Mixing
Vessel



New Highly Pathogenic
Human Strain

The Threat of RNA Viruses Conclusion

- Viruses that pose the greatest threat to the world population are those that originate in animals (zoonotic) and jump to people
- RNA mutations can produce a virus that is especially deadly to humans
- Viruses that exist today (including SARS-CoV-2) such as H5N1, H7N9, MERS, Ebola, all continue to pose a threat to the world


Questions

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