

Emerging Infectious Disease

Objectives

- Understand the viral antigenic variations of influenza virus .
- List the different hosts for influenza (according to influenza type), MERS-Cov and SARS .
- Be familiar with the famous pandemics for each of these viral infections, and measures used to contain spread .
- Identify the different elements in the infection cycle for these viral infections .
- Provide appropriate prevention and control measures for each of these viral infections .
- Outline how to take history of risk factors, and how to give preventive advise.

Be familiar with all 3 diseases
Important lecture!

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What is an emerging infectious diseases?

Emerging infectious diseases are those that:

1. Occur among humans for the first time
2. Occurred previously in a small number and suddenly increased in number
3. Have been occurring throughout history but only recently recognized as distinct diseases

1 Influenza virus

- Orthomyxoviridae
- Virus subtypes are antigenically distinct (no cross-immunity)
- Frequently subject to antigenic variation Antigenic changes occur in types A or Type B, with type C being stable

Influenza Virus: types and variation

Antigen type	Who does it infect?	What does it cause?
A	Human	Seasonal epidemic, pandemic
B	Human	Seasonal Epidemic
C	Human	Mild respiratory illness
D	Cattle	---



Influenza A subtypes

Subtypes are based on the two surface proteins;

- Hemagglutinin (H); antigen initiates infection
- Neuraminidase (N); antigen releases virus into cell

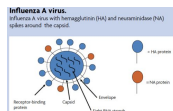
There are:

- 18 hemagglutinin subtypes (H1 to H18)
- 11 neuraminidase subtypes (N1 to N11)

Influenza A subtypes infective to humans:

Currently circulating viruses type A are:

- H1N1 **responsible for pandemics** (this is the doctor's note and a golden note)
- H3N2



Influenza Type B

Type B influenza does not have subtypes, It can be divided into two lineages:

- B/Yagamata
- B/Victoria



Antigenic variations

Antigenic drift

- Happens continually over time.
- Results from point mutation of the gene -> changes in surface proteins¹.

Antigenic Shift

- Complete sudden change
- Results from genetic recombination of human virus with animal or avian virus Responsible for pandemic strains².

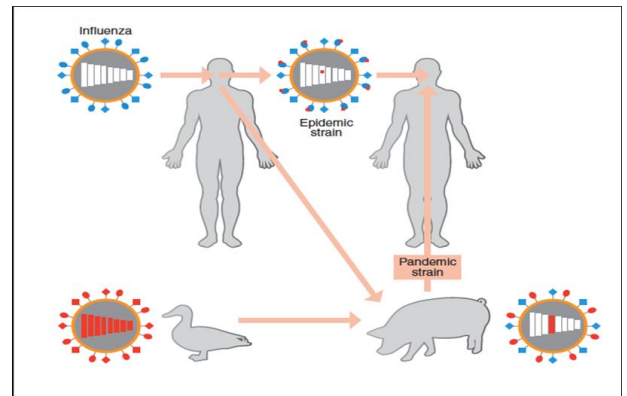
Three different methods for antigenic shift:

- 1- virus from human and avian reassort in the swine.
- 2- virus jumps from avian to human.
- 3- virus jumps from avian to swine to human without Reassortment



What does this mean?

- Antigenic drifts produce viruses with similar antigenic properties -> Cross-Protection^{3,4}
- Antigenic shifts happen less frequently than antigenic drifts
- Type A viruses undergo both antigenic drift and shift.
- Type B viruses undergo antigenic drift only

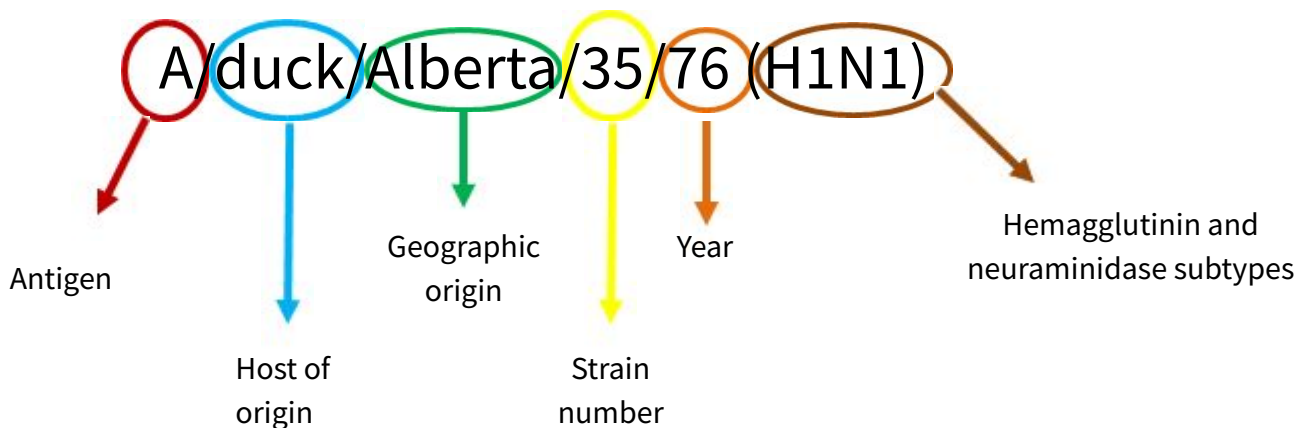


Naming of influenza viruses:

These are named in the following order:

1. The antigenic type (e.g., A, B, C)
2. The host of origin (e.g., swine. For human-origin viruses, no host of origin designation is given.)
3. Geographical origin
4. Strain number (السلسلة الحبيبي)
5. Year of isolation
6. For influenza A viruses, the hemagglutinin and neuraminidase antigen description in parentheses

Example of naming: 'What does this mean?'



- **A/Perth/16/2009 (H3N2)** No host origin because from human

1: The result is a mutated virus.

2: The result is a new virus.

3: Cross-protection is the inability of a new virus strain to cause infection in a host that is already infected with another similar strain of that same virus.

4: Why do some people get the flu more than 1 time, although they are vaccinated? This is due to antigenic drift. The small changes that occur from antigenic drift produce viruses that are closely related to one another, however these small changes can accumulate over time and result in viruses that are antigenically different.

Reservoir, Mode of Transmission, Symptoms, and Diagnosis

Differentiate between them in Influenza virus, MERS-CoV and SARS-CoV

1

Reservoir of influenza:

- Animals (swine, horses, dogs, cats)
- Birds (poultry, wild birds)
- human

2

Characteristics of influenza infection:

- Source of infection is an infected host (a case or subclinical)
- Secretions of respiratory tract are infective
- **Period of infectivity: 1-2 days prior to symptoms, and 5-7 days after symptom onset**
- Portal of entry: respiratory tract
- Incubation period: 18 – 72 hrs

3

Symptoms:

- Fever, chills, aches, coughing, generalized malaise
- Fever lasts for 1-5 days (average 3 days)

4

Complications:

- Secondary bacterial infection¹
- Pneumonia
- Raye syndrome²
- Sinusitis
- Otitis media
- Bronchitis

5

Diagnosis:

- Testing should not be done for all
- Useful in order to verify if the influenza is a cause of an outbreak
- Specimen collected within 3-4 days of illness:
- Nasopharyngeal swab; nasal swab; nasal wash or aspirate; lower respiratory tract

6

Lab tests:

- Viral culture
- Serology
- rRT-PCR³

7

Mode of transmission:

- person-to-person by droplet or droplet nuclei
- Touching surface contaminated with influenza virus



8

Risk factors for infection:

- Season: Winter or rainy season
- Age: More severe disease in older age and children younger than 18 m
- Overcrowding
- Contact with infected individual
- Immunity
- Antibody against H antigen vs. antibody against N antigen
- High risk for severe disease:
 - Chronic diseases; pregnant; elderly; DM; CHD; CLD; Imm

1: Whether it's upper or lower respiratory tract infection.

2: Reye syndrome is characterized by hepatic failure and encephalopathy. It occurs after a viral infection in children who use aspirin during the infection.

3: Confirmatory test.

Historical Pandemics

Date of Pandemic	Influenza subtype	Death Toll
1918-1919	Spanish influenza H1N1	50 million
1957-1958	Asian influenza H2N2	2 million
1968-1969	Hong kong influenza H3N2	1 million
2009-2010	H1N1 (swine flu) - novel subtype	18.2 thousand +

Signs of an outbreak :

01

Starts with few cases

02

Sudden outburst of disease

03

Increased febrile illness in children followed by adults

04

Increased hospitalization due to illness

05

Attack rates are high: 5-10% in adults; 20-30% children

06

Epidemic peaks within 3-4 weeks then declines

Control of Infection and Prevention

Prevention of influenza :

- Follow cough etiquette (cover mouth and nose while sneezing)
- Wash hands
- Vaccination to prevent severe disease

Influenza vaccine:

- Provides 90% protection in healthy adults
- Reduce severity of disease by 60%; death by 80%
- Usually takes **two weeks** after vaccination for body to produce immunity
- One vaccine for northern hemisphere and one for southern hemisphere
- Immunity against two type A (H1N1; H3N2) , and B (trivalent)
- Immunity against two type A and two B

Flu vaccines available in KSA:

Injection vaccine:

- Inactivated virus
- **Ages 6 months and above**
- Safe for pregnant women
- Targets H antigen



Nasal spray vaccine:

- Live weakened virus
- **Ages 2y to 49 y**
- **NOT safe for pregnant women**
- Targets both H and A antigens



According to the MOH the following are recommended for flu vaccination:

- All Diabetics
- Individuals with asthma; COPD
- Patients with chronic cardiac diseases; chronic renal diseases; chronic liver diseases
- Neurological Disorders
- Immune deficiency patients
- Morbidly obese individuals
- Pregnant women
- 6 m - 18 y on long term Aspirin therapy
- Children aged 6m – 5y; adults 50+ y¹
- All healthcare workers

Vaccine complications and contraindications:

symptoms that appear in the first 48 hours:

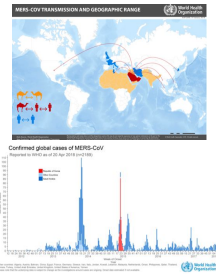
- Mild redness or swelling at the injection site
- Slight rise in temperature
- Minor body aches
- Sore throat

Contraindications (the Doctor might ask a question)

- Those who have severe egg allergy Previous history of severe allergy to influenza vaccine **Yes there are vaccine modifications where egg allergies aren't contradicted but we don't know of KSA has them so we make sure they don't have egg allergies**
- History of Guillain Barre Syndrome after taking the vaccine
- Children under 6 months
- People suffering from very high or moderate temperature

2 Middle East Respiratory Syndrome (MERS-CoV)

- Caused by the coronavirus
- First discovered in Saudi in 2012 **due to socioeconomics (camel owners)**
- It was a novel virus
- Majority of cases were due to unprotected healthcare provision
- Reported in the following countries (80% of cases were in KSA):
 - Algeria, Austria, Bahrain, China, Egypt, France, Germany, Greece, Islamic Republic of Iran, Italy, Jordan, Kuwait, Lebanon, Malaysia, the Netherlands, Oman, Philippines, Qatar, Republic of Korea, Saudi Arabia, Thailand, Tunisia, Turkey, United Arab Emirates, United Kingdom, United States, and Yemen.



Reservoir, Mode of Transmission, Symptoms, and Diagnosis

1

Source of MERS-CoV:

- Animals in the Arabian peninsula
- Dromedary camels
- May have been in bats and transmitted to camels sometime in the past

2

Incubation period & transmission:

- **Incubation: 2-14 days**
- **Mode of transmission:**
 - Person-to-person(patient- to-HCW)
 - Camels-to-humans (unknown route or infection cycle)

1: Because the age group itself is a risk factor.

- 3 Symptoms:**
- Fever
 - Cough
 - Shortness of breath
 - asymptomatic or mild symptoms
 - GI symptoms

- 4 Complications:**
- Pneumonia: respiratory failure (require ventilator)
 - Death (30-40% of infected)
- ★ Why do we worry about MERS-COV more than COVID-19? Due to the high case fatality rate

- 5 Risk factors for infection:**
- People in close contact with a confirmed MERS case
 - Healthcare personnel who do not use recommended infection-control precautions
 - People who have been in contact with camels; visiting farms
 - Consumption of raw animal products
 - Elderly, immunocompromised, chronic disease

- 6 Diagnosis:**
- Nasopharyngeal swab -> rRT-PCR
 - If negative -> retest lower respiratory specimen¹
 - Cases should be reported within 24 hrs (category 1 reportable disease)

- 7 Treatment:**
- No treatment is available
 - Only treatment to relieve symptoms
 - Support vital organ functions in severe cases
 - No vaccine is available

- 8 Prevention:**
- Handwashing
 - Cough etiquette
 - Avoid touching your eyes, nose and mouth with unwashed hands
 - Avoid personal contact, or sharing cups or eating utensils, with sick people
 - Clean and disinfect frequently touched surfaces and objects, such as doorknobs
 - Healthcare workers practice infection control precautions; negative pressure room, masks...etc

3 Severe Acute Respiratory Syndrome (SARS-CoV)

- Also an infection caused by coronavirus
- First reported in Asia in 2003
- Spread to more than 24 countries around the world
- 8,098 cases -> 774 deaths
- No cases have been reported after 2004
- **Reservoir: Horseshoe bats**



- 1 Symptoms:**
- High fever
 - Headache
 - Overall feeling of discomfort
 - Generalized body aches
 - Mild respiratory symptoms
 - Dry cough
 - Diarrhea
 - **Complications:** Pneumonia; pulmonary decompensation; ARDS

1: Due to high false negative.

2

transmission:

- Direct: Person-to-person; respiratory
- Droplets Indirect: Contacting surface contaminated with respiratory droplets
- May be airborne ? **it spreads very quickly they think it may be airborne In healthcare setting:**
Aerosol-generating procedures
- Virus shed in stool – not clear feco-oral transmission
- Incubation period: 2 – 7 days

3

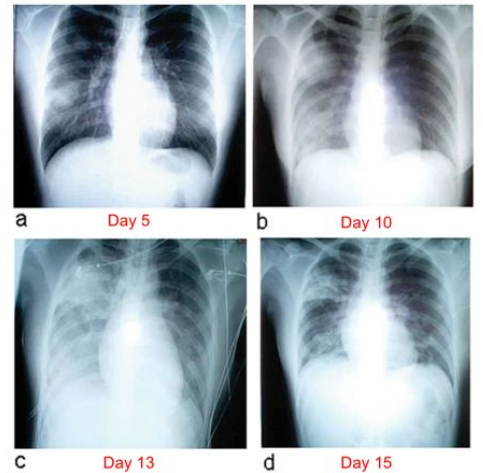
Diagnosis:

- Usually based on history
- If history suggest SARS and X-ray normal; thin cut CT
- Laboratory: rRT-PCR¹

4

Signs of chest x-ray:

- Unilateral patchy shadowing
- **After 1-2 days:** bilateral interstitial infiltration
- **Later: Air-space opacities**



5

Treatment²:

- No clear scientifically proven treatment available
- Severe cases require intensive care
- **Antiviral treatment is questionable; some studies suggest poorer outcomes for those receiving antiviral agents.**

6

Prevention & control:

- No vaccine available
- Handwashing and infection control precautions
- **In case of reported cases, early identification and efficient reporting of cases³**
- Isolation of patients with infection
- **Exit screening for international travelers⁴**
- Appropriate protection of medical staff caring for patients⁵

1: Confirmatory test.

2: Supportive treatment.

3: Helped in decreasing the number of infection in those 2 years.

4: الحوار الصحي

5: Providing PPE, training medical staff, develop an infection control program, etc..

Quiz

MCQ

1- Which type of influenza virus causes pandemics?

- A. Type A B. Type B C. Type C D. All of them

2- What does X denotes in this nomenclature, A/duck/X/Y/Z (H1N1) influenza virus?

- A. Antigen B. Year C. Strain number D. Origin

3- What is the main reservoir for influenza A?

- A. Animals B. Soil C. Human carriers D. Water pools

4- Which of the following requires 2nd level prevention?

- A. Leprosy B. Ebola C. MERS-CoV D. Malaria

5- Which of the following is the most common symptom of MERS-CoV?

- A. Muscle aches B. Bloody diarrhea C. Fever D. Abdominal pain

6- What is the main reservoir for SARS Co-V?

- A. Camel B. Horseshoe bat C. Wild birds D. Dogs

Answers

Q1	Q2	Q3	Q4	Q5	Q6
A	D	A	C	C	B





Thank You and
Good Luck



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