



## **Emerging Infectious Diseases**

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# 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

# What is an emerging infectious diseases?

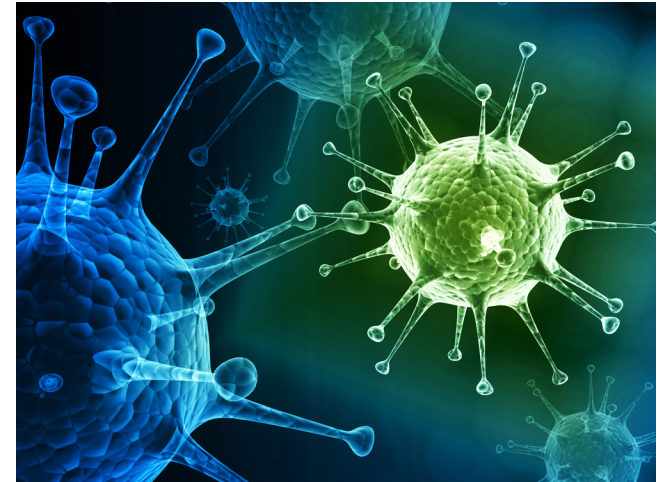
- Emerging infectious diseases are those that:
  1. Occur among humans for the first time
  2. Occurred previously in a small number and suddenly increased in number
  3. Have been occurring throughout history but only recently recognized as distinct diseases



# 1. Influenza Virus

# 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



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# **Influenza Virus: Types and Variation**

# Antigenic Types of Influenza Virus

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

**There are:**

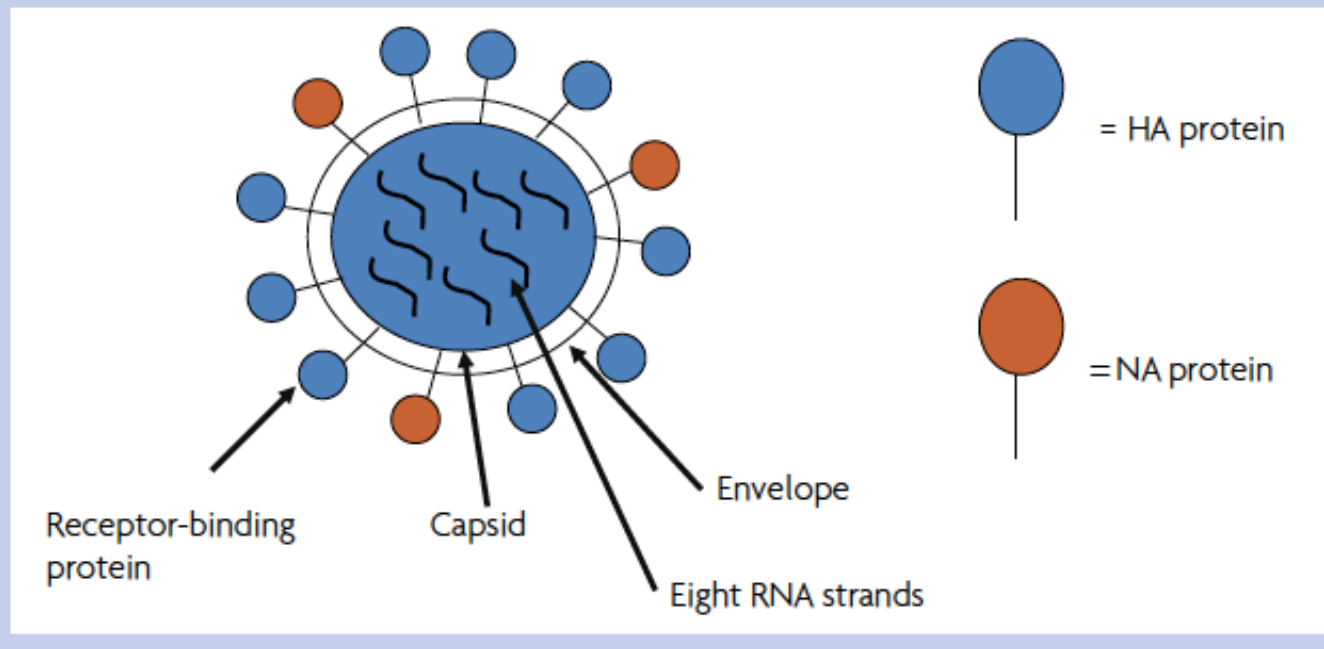
- 18 hemagglutinin subtypes (H1 to H18)
- 11 neuraminidase subtypes (N1 to N11)



# Influenza A Virus

## Influenza A virus.

Influenza A virus with hemagglutinin (HA) and neuraminidase (NA) spikes around the capsid.



# Influenza A subtypes infective to humans

- Currently circulating viruses type A are:
  - $H_1N_1$
  - $H_3N_2$

# Influenza Type B

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- Type B influenza does not have subtypes
- It can be divided into two lineages:
  - B/Yagamata
  - B/Victoria

# Antigenic Variation

## 1. **Antigenic Shift**

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

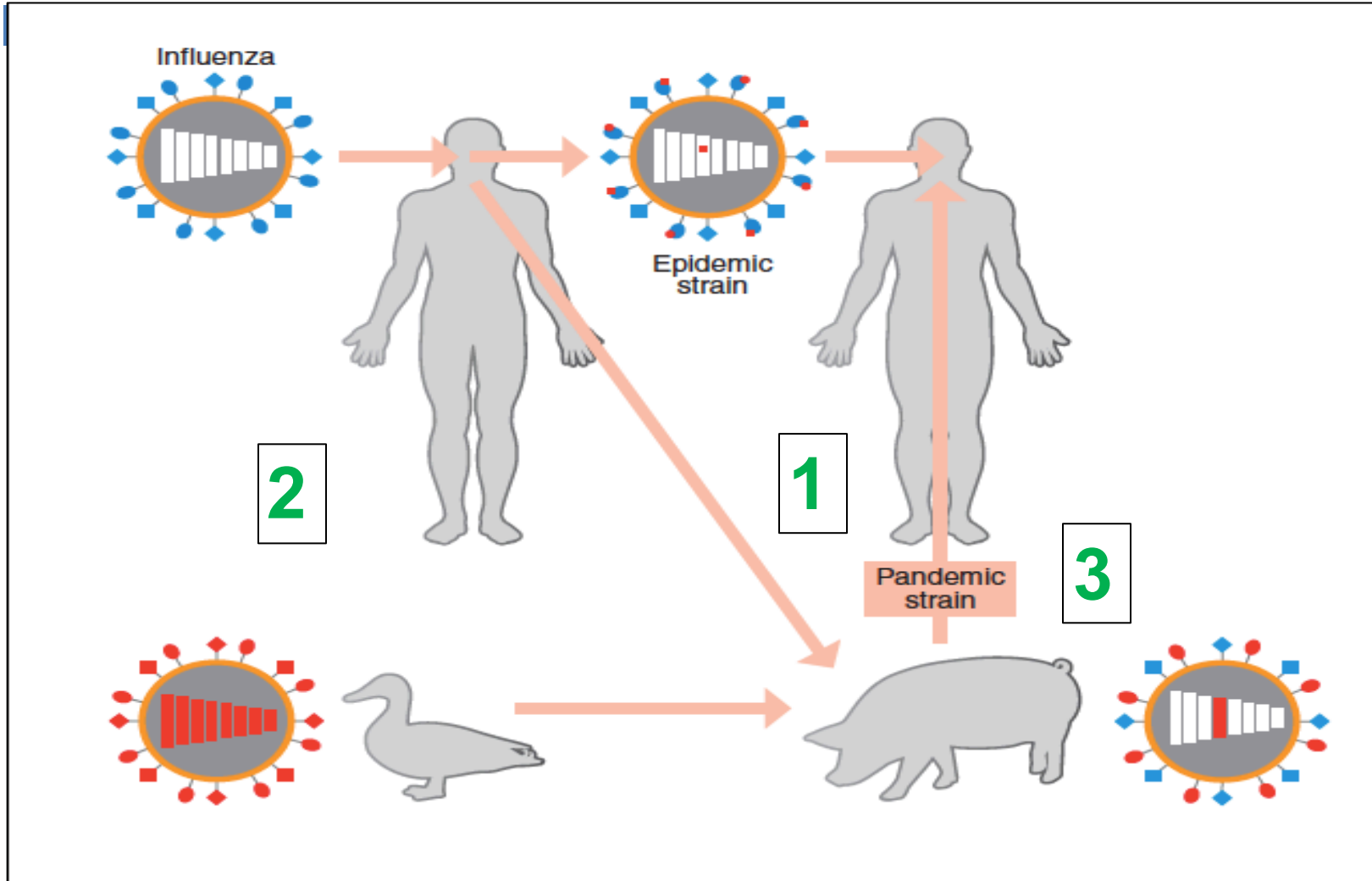
## 2. **Antigenic drift**

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

# What does this mean?

- Antigenic drifts produce viruses with similar antigenic properties -> cross-protection
- Antigenic shifts happen less frequently than antigenic drifts
- Type A viruses undergo both antigenic drift and shift
- Type B viruses undergo antigenic drift only

# Antigenic Shift



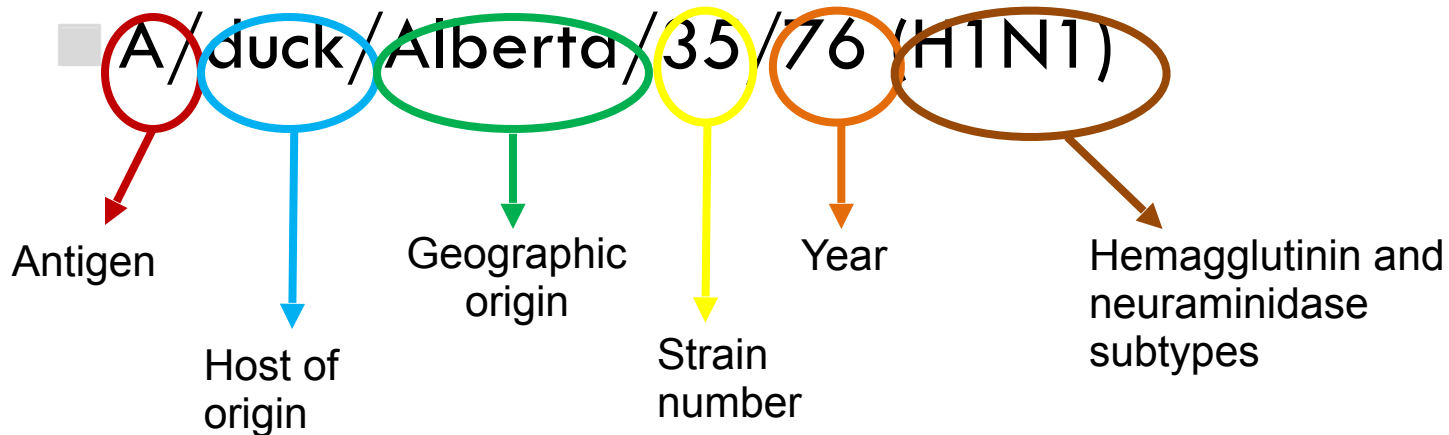
Source: Doherty PC, Turner SJ. Q and A: What do we know about influenza and what can we do about it? J Biol 2009; 8: 46

# Naming of Influenza Viruses

- These are named in the following order:
  - The antigenic type (e.g., A, B, C)
  - The host of origin (e.g., swine. For human-origin viruses, no host of origin designation is given.)
  - Geographical origin
  - Strain number
  - Year of isolation
  - 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





# **Reservoir, Mode of Transmission, Symptoms, and Diagnosis**

# Reservoir for Influenza

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

# 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

# Symptoms

- Fever, chills, aches, coughing, generalized malaise
- Fever lasts for 1-5 days (average 3 days)
- Complications:
  - Secondary bacterial infection
  - Otitis media
  - Sinusitis
  - Bronchitis
  - Pneumonia
  - Raye syndrome

# 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
- Lab tests:
  - Viral culture
  - Serology
  - rRT-PCR

# Mode of transmission

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



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# 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; Immunocompromised

# Historical Pandemics



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Date of Pandemic	Influenza Subtype	Death Toll
1918-1919	Spanish Influenza H <sub>1</sub> N <sub>1</sub>	50 million
1957-1958	Asian Influenza H <sub>2</sub> N <sub>2</sub>	2 million
1968-1969	Hong Kong Influenza H <sub>3</sub> N <sub>2</sub>	1 million
2009-2010	H <sub>1</sub> N <sub>1</sub> (Swine flu) – novel subtype	18.2 thousand +

# Signs of an Outbreak

- Starts with few cases
- Sudden outburst of disease
- Increased febrile illness in children followed by adults
- Increased hospitalization due to illness
- Attack rates are high: 5-10% in adults; 20-30% children
- Epidemic peaks within 3-4 weeks then declines



# **Control of Infection and Prevention**

# Prevention of Influenza

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- 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 ( $H_1N_1$ ;  $H_3N_2$ ) , 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+ y
- All health care workers

# Vaccine Complications and Contraindications

- Complications include symptoms that appear for no more than 48 hours:
  - Mild redness or swelling at the injection site
  - Slight rise in temperature
  - Minor body aches
  - Sore throat
- **Contraindications:**
  - Those who have severe egg allergy
  - Previous history of severe allergy to influenza vaccine
  - History of Guillain Barre Syndrome after taking the vaccine
  - Children under 6 months
  - People suffering from very high or moderate temperature



## 2. Middle Eastern Respiratory Syndrome (MERS-CoV)



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# MERS-CoV

- Caused by the coronavirus
- First discovered in Saudi Arabia in 2012
- It was a novel virus
- Majority of infections occurred in healthcare setting (unprotected healthcare provision)
- Countries in which the virus was reported:
  - *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*
- Around 80% of cases reported in Saudi Arabia



# **Reservoir, Mode of Transmission, Symptoms, and Diagnosis**

# Source of MERS-CoV

- Animal source in the Arabian peninsula
- The virus has also been found in camels (Dromedary camels)
- May have originated in bats then transmitted to camels sometime in the past ?



# Symptoms

- Fever
- Cough
- Shortness of breath
- Could present with mild symptoms
- Could be asymptomatic
- GI symptoms

## Complications

- Pneumonia ; respiratory failure -> ventilator
- Death reported in 30% to 40% of infected people

# MERS-CoV cont.

## ■ Incubation period

- 2 – 14 days

## ■ Mode of transmission

- Person-to-person (close contact) ; from patient to healthcare worker; family members; between patients
- From camels to humans; Exact route of transmission and role of camel in the infection cycle is not known

# Risk Factors for Infection MERS-CoV

- People who have had close contact, such as caring for or living with, a confirmed case of MERS
- Healthcare personnel who do not use recommended infection-control precautions
- People who have had contact with camels; visiting farms
- Consumption of raw animal products
- Elderly; immunocompromised; chronic disease

# Diagnosis of MERS-CoV

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



# Treatment of MERS-CoV



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

# Prevention of MERS-CoV

- 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.*

## MIDDLE EAST RESPIRATORY SYNDROME CORONAVIRUS; GUIDELINES FOR HEALTHCARE PROFESSIONALS



### **3. Severe Acute Respiratory Syndrome (SARS-CoV)**

# 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 bat



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# Mode of transmission

- Direct: Person-to-person; respiratory droplet
- Indirect: Contacting surface contaminated with respiratory droplet
- May be airborne ?
- In healthcare setting: Aerosol-generating procedures
- Virus shed in stool – not clear feco-oral transmission
  
- Incubation period: 2 – 7 days

# Symptoms

- High fever
- Headache
- Overall feeling of discomfort
- Generalized body aches
- Mild respiratory symptoms
- Dry cough
- Diarrhea

## **Complications**

- Pneumonia; pulmonary decompensation; ARDS



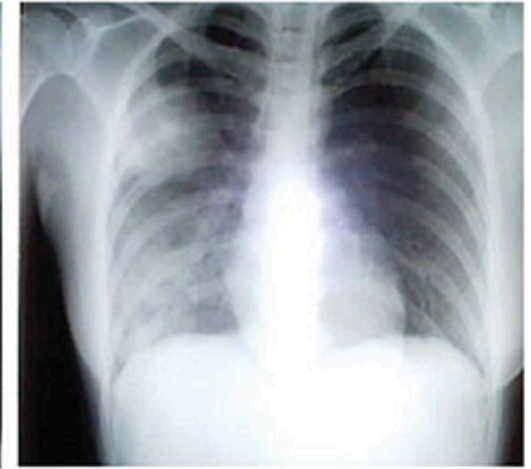
# Signs on chest x-ray

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



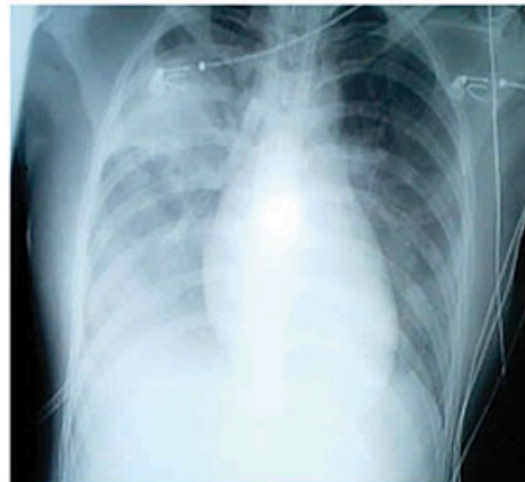
a

Day 5



b

Day 10



c

Day 13



d

Day 15

# Diagnosis

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- Usually based on clinical history
- If history suggestive of SARS and x-ray normal -> thin cut CT
- Laboratory: rRT-PCR

# Treatment



- 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

# Prevention and Control

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

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Any

Questions?