

High Consequence Respiratory Pathogens: Novel Influenza and Middle East Respiratory Syndrome (MERS)

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Conflicts of Interest

- Nothing to disclose



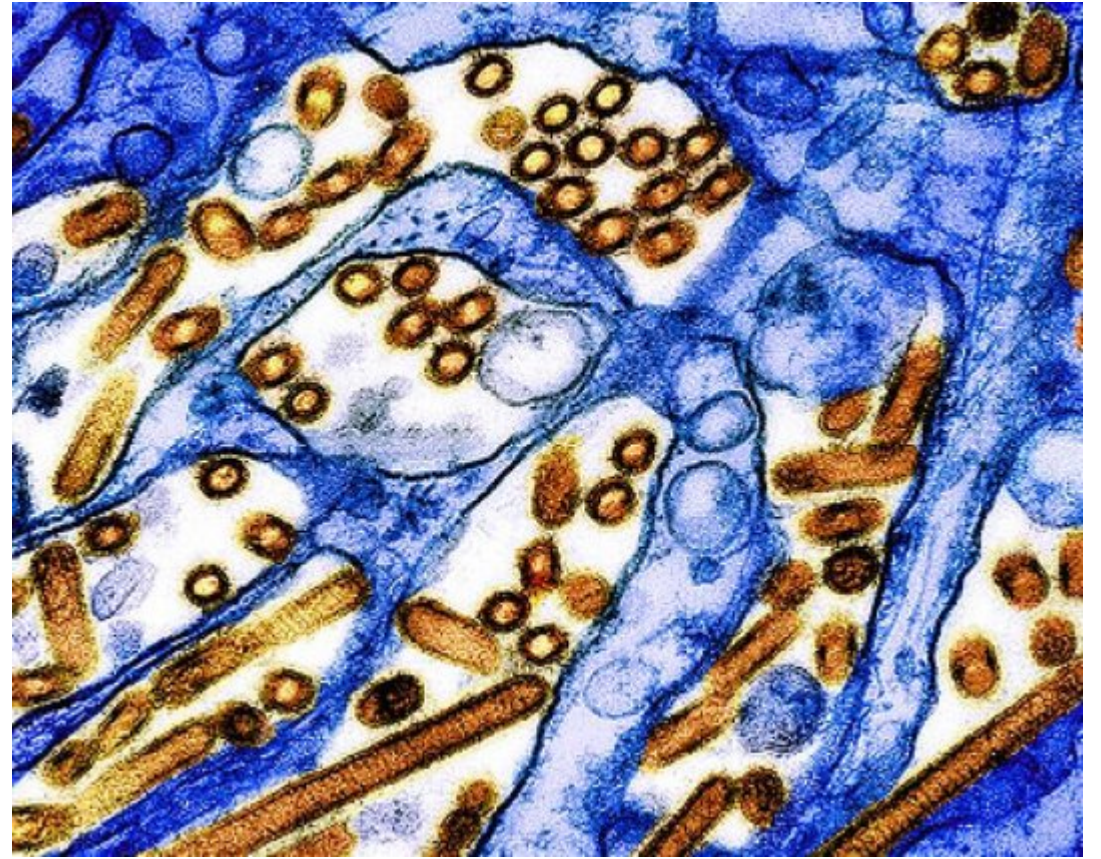
Why focus on these viruses?

Potential for
person-to-person
transmission

High associated
morbidity and
mortality

Limited proven
therapeutic
options

Novel Influenza



CDC & NIAID

“Novel influenza” describes a subset of influenza viruses

- Non-seasonal influenza A virus
- Little community immunity → higher potential for rapid spread and serious disease (AKA “pandemic flu”)
- Starts as zoonotic infection → gains ability to infect humans through sporadic mutations
- H5N1 = most recognized novel influenza currently circulating



Not all novel influenzas pose the same risk

Year	Subtype	Severity of outbreak
1889 to 1890	H2N8*	Severe pandemic
1900 to 1903	H3N8*	Moderate epidemic, probable
1918 to 1919	H1N1, formerly HswN1 [¶]	Extremely severe pandemic
1933 to 1935	H1N1, formerly H0N1 [¶]	Mild epidemic
1946 to 1947	H1N1	Mild epidemic
1957 to 1958	H2N2	Severe pandemic
1968 to 1969	H3N2	Moderate pandemic
1977 to 1978	H1N1	Mild pandemic
2009 to 2010	H1N1	Mild to moderate pandemic ^Δ

UpToDate, Influenza:
Epidemiology and Pathogenesis

H5N1: Historical Perspective

Subtype of Influenza A virus

Virus itself is not new


- First recognized in China in mid-90's in domestic waterfowl

Initially associated with poultry outbreaks w/high mortality


Like other Influenza A viruses, has evolved over time

- Facilitated spread to other continents

Emergence and Evolution of H5N1 BIRD FLU




H5N1



1996-1997 H5N1 bird flu virus first detected

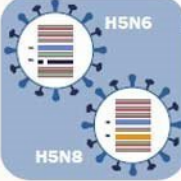
In 1996, highly pathogenic avian influenza H5N1 virus is first identified in domestic waterfowl in Southern China. The virus is named A/goose/Guangdong/1/1996. In 1997, H5N1 poultry outbreaks happen in China and Hong Kong with 18 associated human cases (6 deaths) in Hong Kong. This virus would go on to cause more than 860 human infections with a greater than 50% death rate.

H5N1 spreads 2003-2005




For several years, H5N1 viruses were not widely detected; however, in 2003, H5N1 re-emerges in China and several other countries to cause widespread poultry outbreaks across Asia. In 2005, wild birds spread H5N1 to poultry in Africa, the Middle East and Europe. The hemagglutinin (HA) gene of the virus diversifies into many genetic groups (clades). Multiple genetic lineages (genotypes) are detected.

H5N6 and H5N8 viruses emerge




Gene-swapping of H5 viruses from poultry and wild birds leads to emergence/detection of H5N6 and H5N8 virus subtypes. HA diversifies further into clade 2.3.4.4 in Asia, Africa, Europe, the Middle East and North America. H5 viruses with various neuraminidase (NA) genes continue to be detected, including in U.S. wild birds and poultry.

2.3.4.4b viruses spread widely 2018-2020




H5N6 and H5N8 viruses become predominant globally, replacing the original H5N1 viruses. As of 2022, there have been more than 70 reported H5N6 human infections and 7 H5N8 human infections. The H5 HA diversifies further into clade 2.3.4.4b which becomes predominant in Asia, Africa, Europe, and the Middle East.

H5N1 clade 2.3.4.4b



2021-2022 H5N1 found in Canada, US

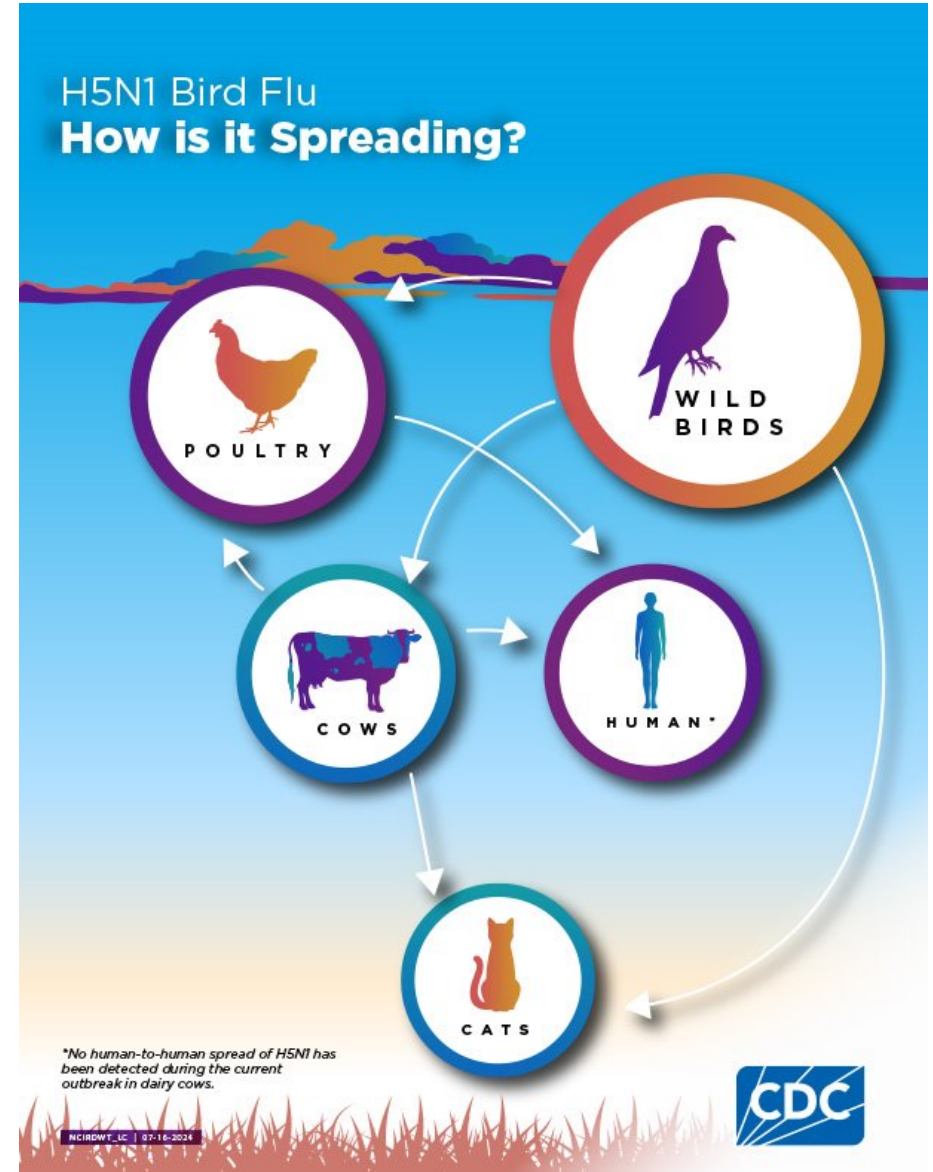
A new H5N1 virus belonging to clade 2.3.4.4b with a wild bird adapted N1 NA gene emerges. Clade 2.3.4.4b H5N1 viruses become predominant in Asia, Africa, Europe, and the Middle East by the end of 2021. The virus is detected in Canada and U.S. wild birds in late 2021. In February 2022, the virus begins causing outbreaks in U.S. commercial and backyard poultry. At this time, two human cases with current H5N1 bird flu viruses have been reported. One occurred in the United Kingdom in 2021 and one in the United States in 2022. More information is available: <https://www.cdc.gov/flu/avianflu/in/humans.htm>



C332646.A

H5N1: Contemporary Events

- Clade 2.3.4.4b emerges in 2020 in wild birds --> global spread --> detected in US and Canada by end of 2021
 - Now detected in commercial, domestic and/or wild birds in all 50 states
- **2024: detection in livestock including dairy cattle**



Human infections with H5N1 are not new

Data prior to 2024

- Sporadic cases since 1997
- Majority w/direct (unprotected) exposure to infected animals (mostly poultry)
 - Few cases of limited human-to-human transmission after prolonged unprotected exposure
- High case fatality ratio (~50%)

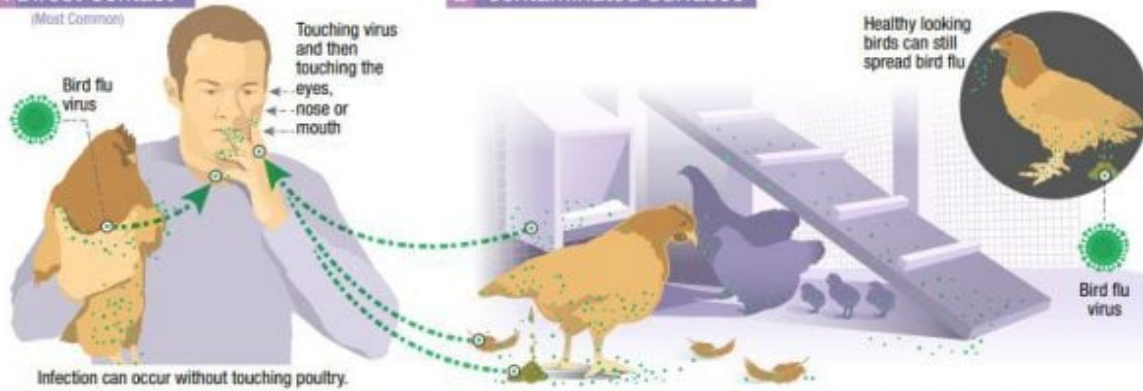
Human infections in US since 2024

- 71 confirmed cases
- Majority w/direct (unprotected) exposure to poultry or dairy
 - No confirmed human-to-human transmission, though 3 w/unknown exposure
- Most cases mild, 2 deaths

How Infected Backyard Poultry Could Spread Bird Flu to People

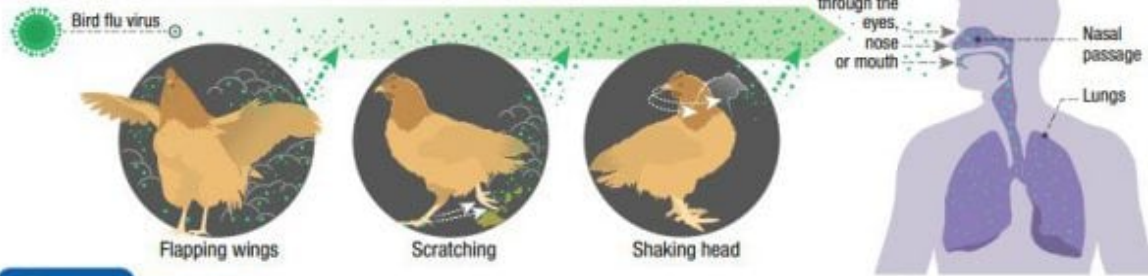
Human Infections with Bird Flu Viruses Rare But Possible

1 Direct Contact (Most Common)



2 Contaminated Surfaces

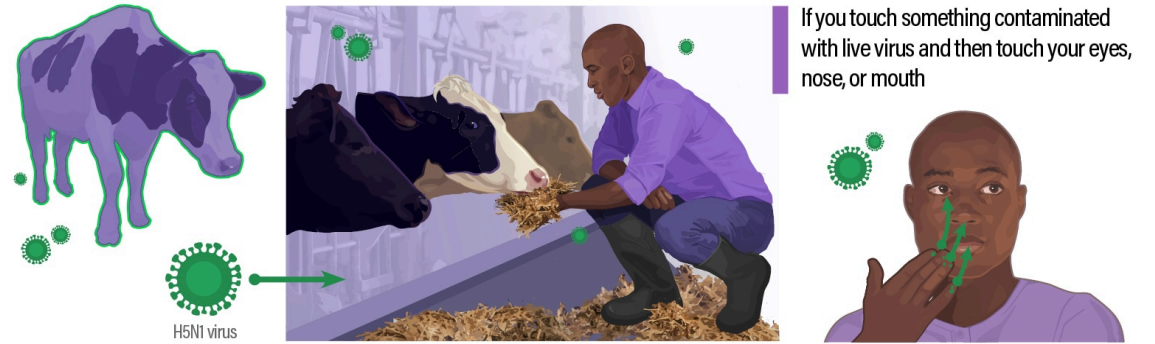
3 Bird Flu Virus in the Air (in Droplets or Dust)



www.cdc.gov/flu/avianflu/avian-in-humans.htm

03/01/10

H5N1 Bird Flu Might Spread from Cows to People in Several Ways



If a liquid contaminated with live virus splashes into your eyes (like raw milk from an infected cow, for example)



36850-A

Other novel influenza viruses of interest

Ducks identified as source of H10N5 avian flu in Chinese woman's coinfection

News brief | February 13, 2024

[Lisa Schnirring](#)

Topics: [Avian Influenza \(Bird Flu\)](#)

Brazil reports fatal H1N1v flu case

News brief | June 20, 2023

[Lisa Schnirring](#)

Topics: [Influenza Variants](#), [Swine Influenza](#)



Brazilian health officials have reported a fatal swine-origin variant H1N1 (H1N1v) case to the [World Health Organization \(WHO\)](#), which the group says is part of a sporadic pattern with the virus in the country, with no evidence of human-to-human spread.

The patient is a 42-year-old woman from Parana state who had underlying health conditions. Her symptoms began on May 1, and she was hospitalized 2 days later. She died from her infection on May 5.



James Hill / Flickr cc

3 new human avian flu cases reported in China

News brief | February 11, 2026

[Stephanie Soucheray, MA](#)

Topics: [Avian Influenza \(Bird Flu\)](#)



Leo Malsam / iStock

Hong Kong's Centre for Health Protection (CHP) [yesterday reported](#) two new H9N2 avian flu cases with symptom onsets in December and January, and an H10N3 patient whose illness began on December 29.

The H9N2 cases include a 2-year-old boy from Hunan province who got sick on December 29, and a 73-year-old woman from Guangdong province whose symptoms began in January 17. The influenza A(H10N3) case occurred in a 34-year-old man also from Guangdong province.

Keys for detection

- National surveillance:
 - Sequencing subset of influenza A positive specimens
 - Targeted testing of individuals exposed to infected animals
- Recognizing deviations from typical epidemiology:
 - Off-season rise in influenza cases
 - Deviation from typical clinical presentation
- Local testing patterns:
 - Influenza A cases that are not “sub-typable” on extended viral panels

Prevention

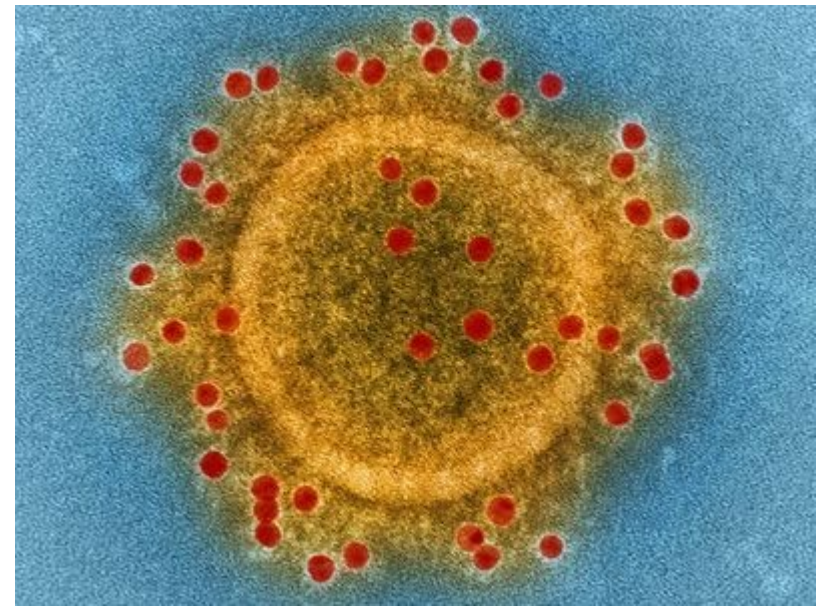
- Community:
 - Avoid sick/dead animals
 - Do not ingest raw food products (including raw milk)
- Healthcare:
 - Identify, Isolate and Inform
 - Standard + Contact + Airborne + Eye protection

CDC Issues Updated Guidance to Help Prevent Spread of Flu at Agricultural Fairs

WHAT TO KNOW

- In March 2024, highly pathogenic avian influenza A(H5N1) virus, also known as "H5N1 bird flu," was reported in cows in the United States.
- CDC has issued updated guidance to help prevent the spread of flu between animals and between animals and people at fairs.
- Taking preventive actions at fairs can help protect exhibitors, visitors, and livestock from flu.



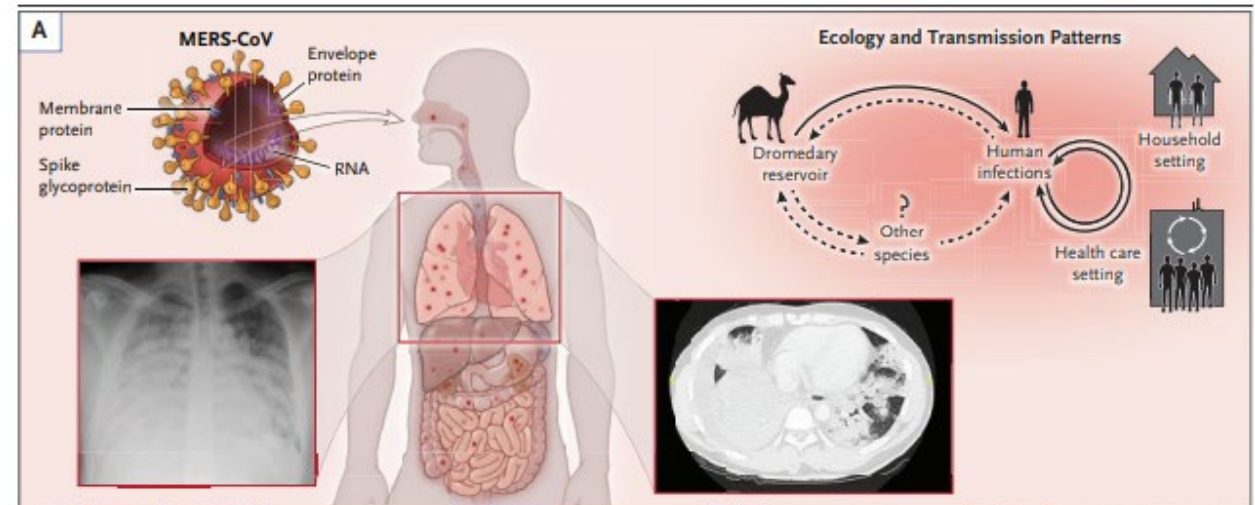


Britannica

Middle East Respiratory Syndrome (MERS)

MERS Background

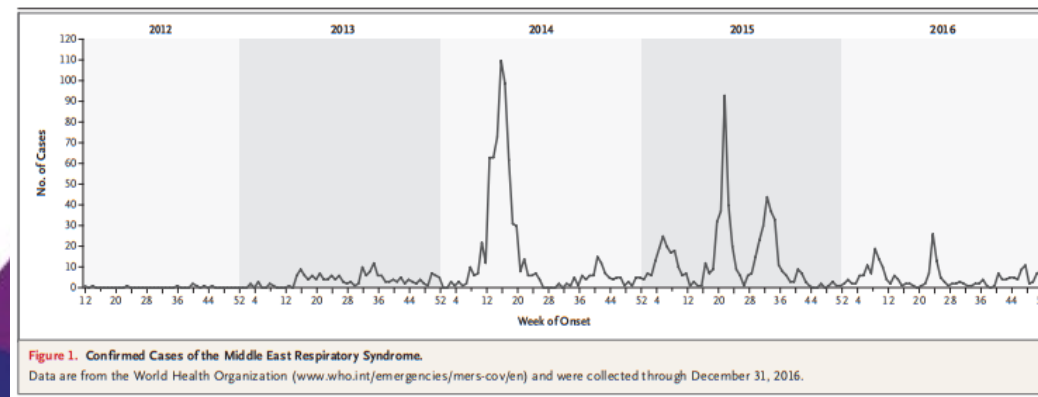
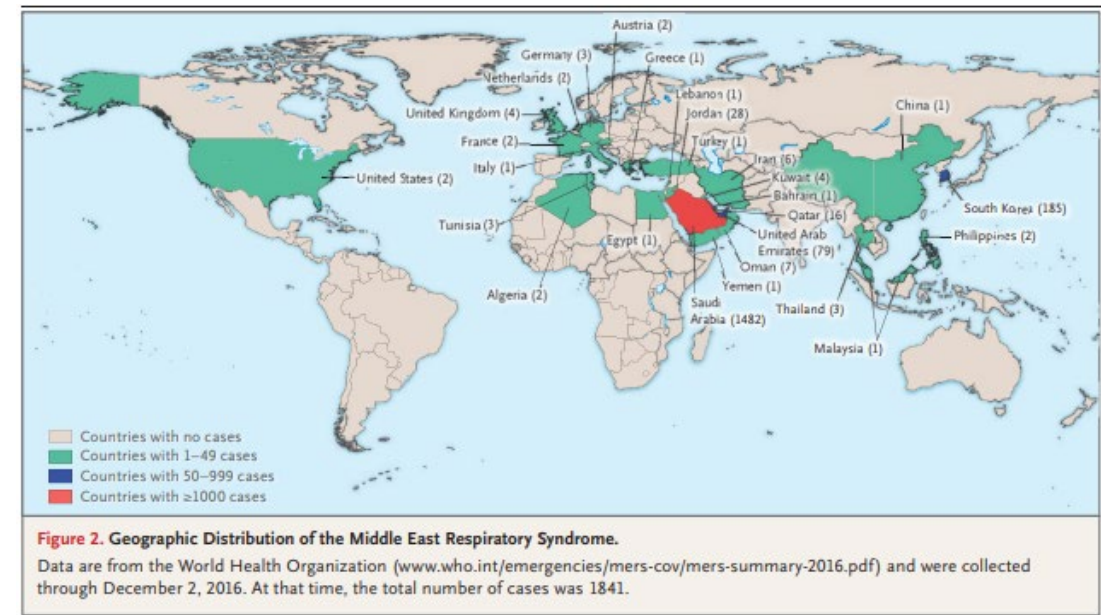
- Caused by MERS coronavirus (MERS-CoV)
- Zoonotic infection: dromedary camels = primary reservoir for transmission to humans
- Non-sustained human-to-human transmission has occurred, mostly in healthcare settings
- Spectrum of disease ranging from mild respiratory illness to respiratory failure and death
- Incubation period: 2-14 days



Arabi NEJM 2017

MERS Timeline and Epidemiology

- 2012: first identified in patient in Saudi Arabia
- As of 12/2025: 2,600 lab-confirmed cases reported to WHO, majority from Arabian Peninsula
 - 84% from Saudi Arabia
 - 37% have died (presumed overestimate)



Middle East Respiratory Syndrome Coronavirus Outbreak in the Republic of Korea, 2015

Korea Centers for Disease Control and Prevention*

Korea Centers for Disease Control and Prevention, Cheongju, Republic of Korea.

South Korean outbreak

- Index case: returning traveler from Bahrain, UAE and Saudi Arabia
- 9 day delay between symptom onset and diagnosis
- 186 confirmed cases across 16 healthcare facilities
- Small number of “superspreaders”, the majority of cases resulted in no secondary cases
- Multiple potential explanations for scope of outbreak

Identify, Isolate and Inform

- **Identify** individuals with compatible symptoms AND epidemiologic links
 - **Symptoms:** flu-like illness +/- PNA
 - **Epi links:** camel exposure (direct or via drinking unpasteurized milk), healthcare exposure and/or exposure to sick individual in Arabian Peninsula
 - **Isolate:** Standard + Contact + Airborne + Eye protection
 - **Inform** infection prevention and local public health authorities
- 