Avian İnfluenza
Mpox ve MERS-CoV

Hayvan–İnsan Arayüzünde Güncel Viral Tehditler



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Tıp Fakültesi

Sunum planı

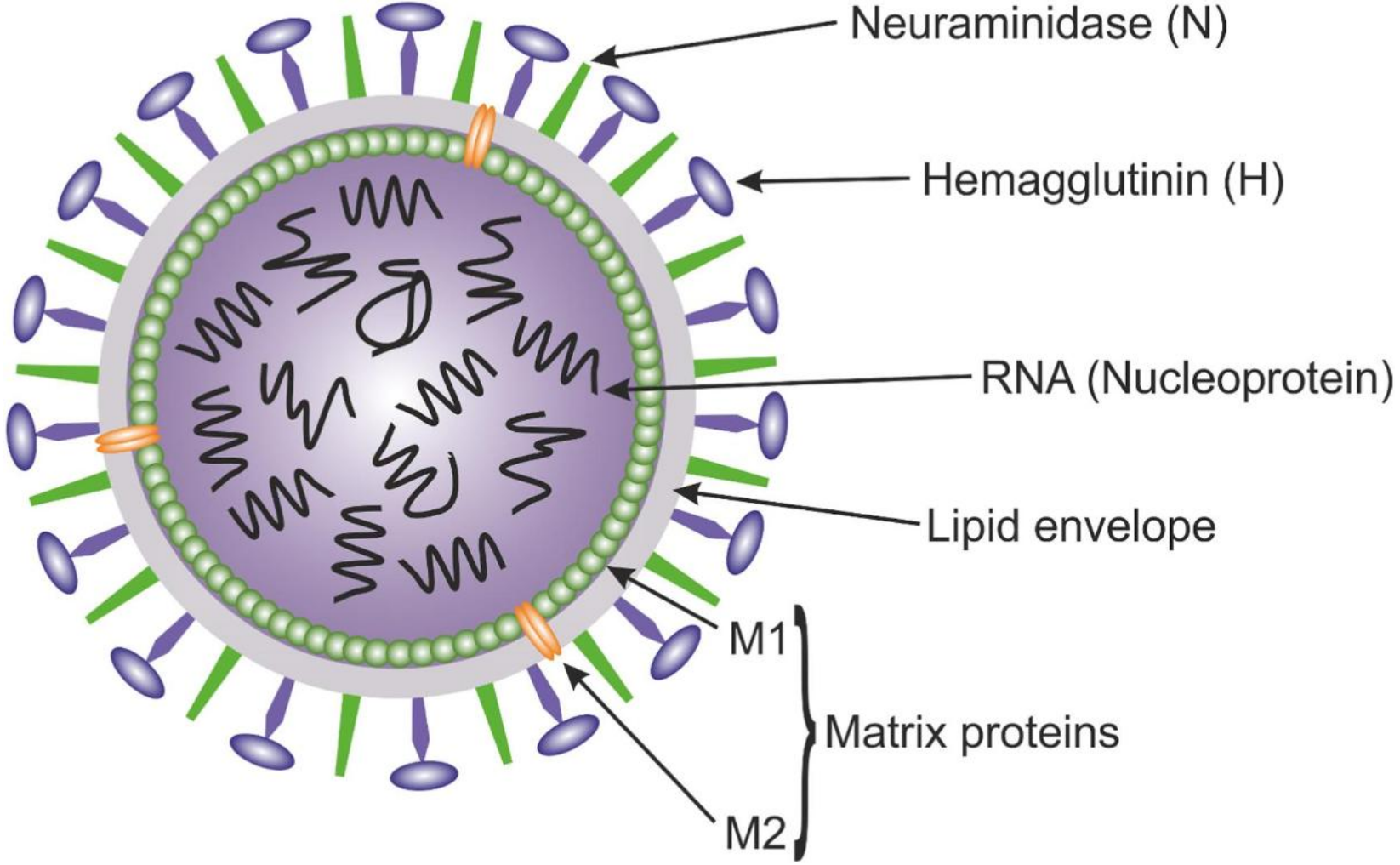
Avian influenza

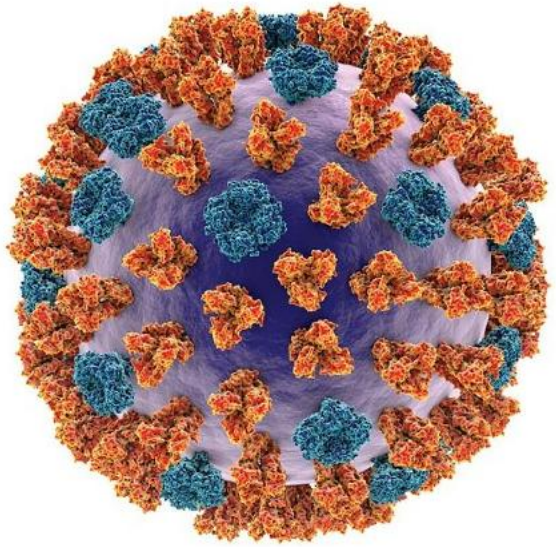
Mpox

MERS-CoV

Güncel durum ve klinik yaklaşım







- Hemaglütinin 19 tip,
- Nöraminidaz 11 tip

Zar içinde hemaglütinin, nöraminidaz ve M2 iyon kanalı
Zar altında M1 matriks proteini
İçeride, sekiz adet viral ribonükleoprotein (vRNP) kompleksi halinde tek iplikçikli RNA

Art F. Y Poon, *Virus Evolution*, Volume 10, Issue 1, 2024

Nayak DP, *Virus Research*. 2009;143(2):147-161.

İnfluenza Virüsünün Tipleri

Tip	Konak	Klinik Özellik	Not
A	İnsan + hayvan (kuş, domuz, at)	Ağır, salgın ve pandemi	Yüksek genetik değişim
B	İnsan	Mevsimsel grip	A'dan genelde daha hafif
C	İnsan, domuz	Hafif, sporadik	Klinik önemi düşük
D	Sığır, domuz	İnsanda yok	Zoonotik

Liang, Y. (2023). Pathogenicity and virulence of influenza. *Virulence*, *14*(1).

Avian influenza

Avian influenza overview December 2024–March 2025

2025 · **43** citations · Leonidas Alexakis et al.

EFSA Journal · DOI

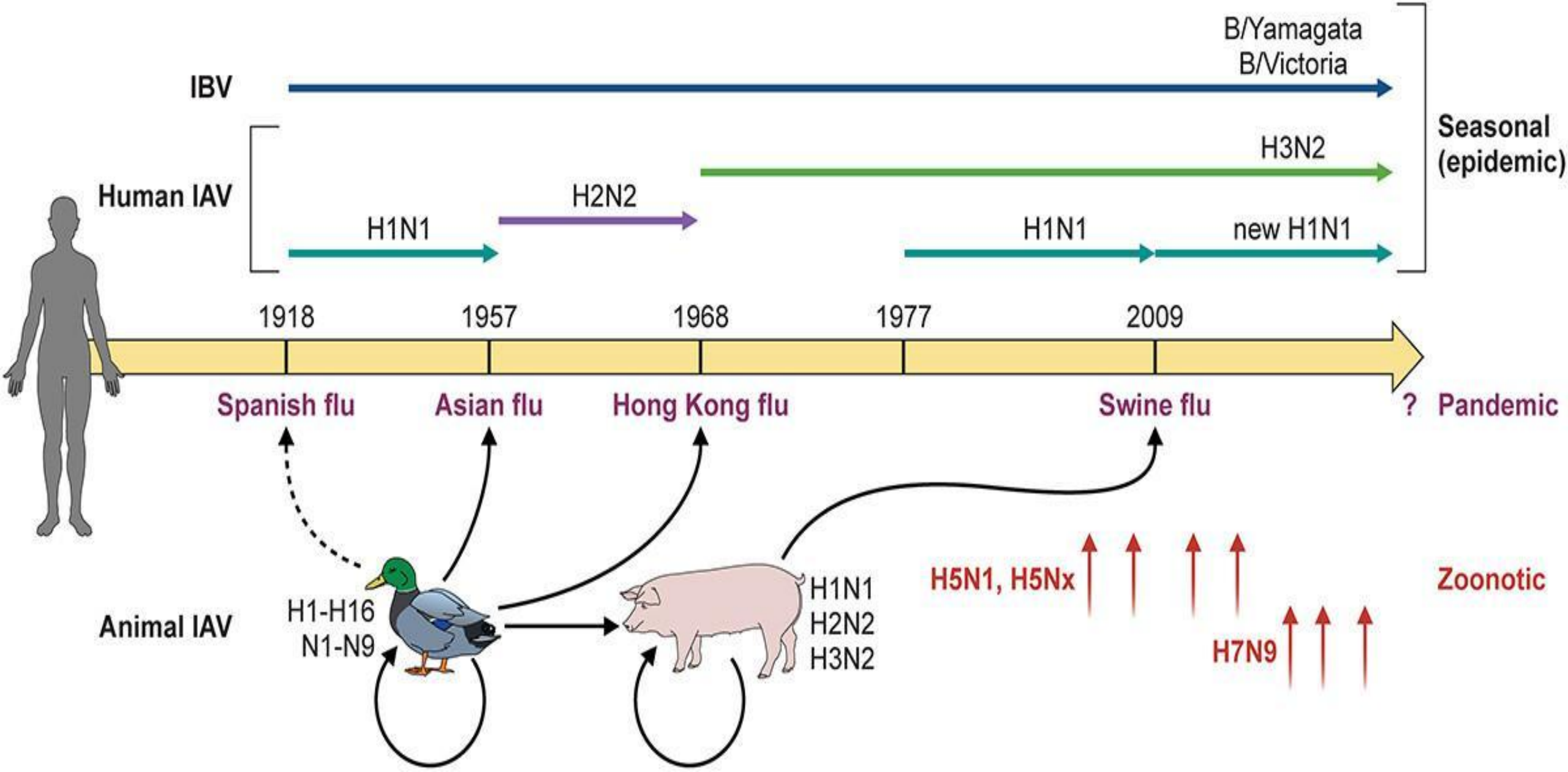
Avian Influenza: Strategies to Manage an Outbreak

2023 · **50** citations · Alison Simancas-Racines et al.

Pathogens · DOI

- Düşük patojen AI--- H9N2, H10N3
- Yüksek patojen AI---H5 &H7
  - Solunum yolu ve gastrointestinal bariyerleri geçer
  - Kuşlar için mortal
- Doğal rezervuar göçmen su kuşları
- Kümes hayvanları ve
- Diğer memelilere bulaş mümkün





Liang Y. Pathogenicity and virulence of influenza. Virulence. 2023 Dec;14(1):2223057.

Avian influenza Epidemiyoloji

Pathogenic Avian Influenza Virus in the Long Way of Evolution

Goose/GD/96 lineage

2.2.
2.2.1.2
2.2.2
2.3.2.1
2.3.4.4 Clade

2.3.4.4b Clade

2.3.4.4b Clade

1959 | 1996-97 | 2003-05 | 2009-16 | 2020-21 | 2022-23

The first HPAIV was isolated in Scotland

1996: First identified in goose in Southern China

1997: First human infections in Hong Kong

2003: China and across Asia

2005: Africa, the Middle East and Europe

2011: Bangladesh, China, Egypt, India, Indonesia, Vietnam and non-enzootic countries

2014: Canada

2015: United States

2020: Europe, Africa, the Middle East and Asia

2021: Netherlands and Estonia

2022: England, Peru, United States, Spain, Canada, China, Alaska

2023: Chile, Brazil, Ecuador



A comprehensive review of highly pathogenic avian influenza (HPAI) H5N1: An imminent threat...

2023 · **228** citations · Javad Charostad et al.

Travel medicine and infectious disease · DOI

Avian influenza Epidemiyoloji

ADIS (Animal Disease Information System) and **WOAH-WAHIS** (World Organisation for Animal Health – World Animal Health Information System)

Avian influenza overview March–May 2026

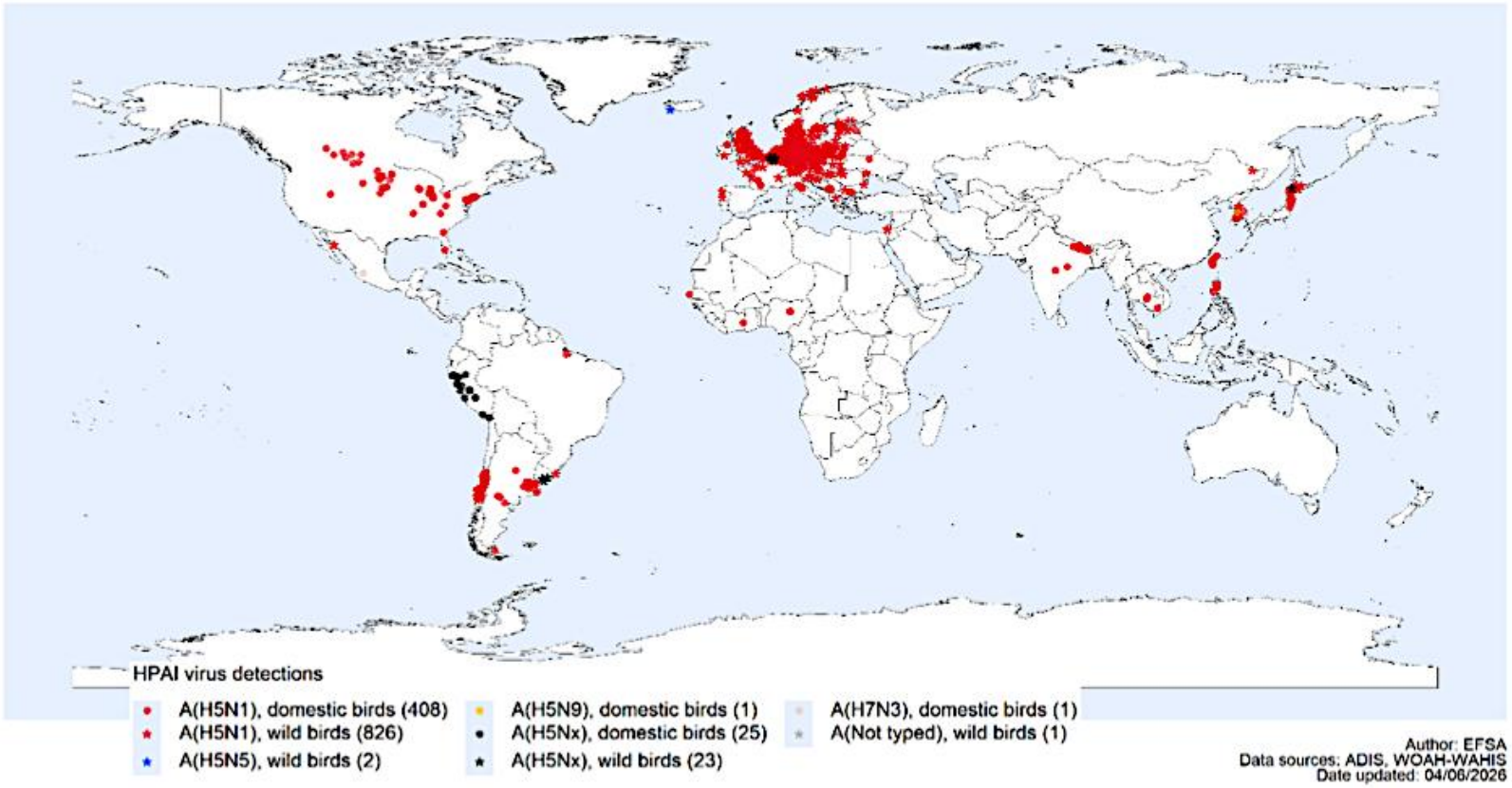


Figure 6: Geographic distribution, based on available geocoordinates, of HPAI virus detections reported worldwide in domestic (435) and wild (852) birds by virus type, from 28 February to 4 June 2026.

Source: ADIS and WOAH-WAHIS (data extraction carried out on 4 June 2026).



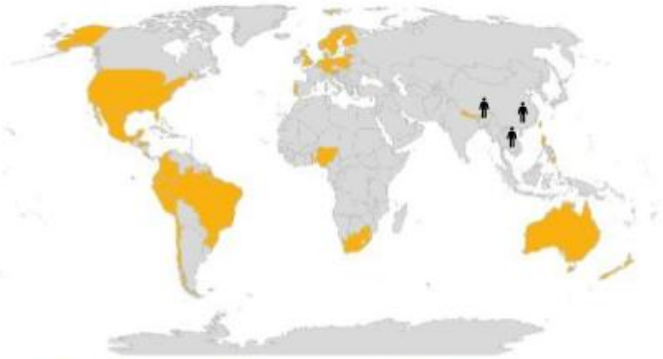
Avian influenza Epidemiyoloji

Avian influenza overview

June–August 2026*

- In Europe, HPAI A(H5N1) virus detections further declined during summer and remained at very low levels in both domestic and wild birds. No new HPAI A(H5N5) virus detections were reported.
- However, HPAI virus detections are expected to increase in the coming weeks with the arrival of migratory birds.
- Outside Europe, HPAI A(H5N1) virus has spread among local wild bird populations in Australia and has further spilled over to mammals following its first introduction to the Australian mainland in June. HPAI A(H5) viruses continued to be detected across the Americas, with Mexico reporting HPAI A(H7N3) virus detections in wild birds.

HPAI outbreaks in birds and human AI cases



12 Countries in Europe** + **18** Countries outside Europe = **30** Countries worldwide

Countries with publicly confirmed cases

Sources: ADIS/WOAH-WAHIS (birds), ECDC line list (humans); **as defined in Table 1 of the report

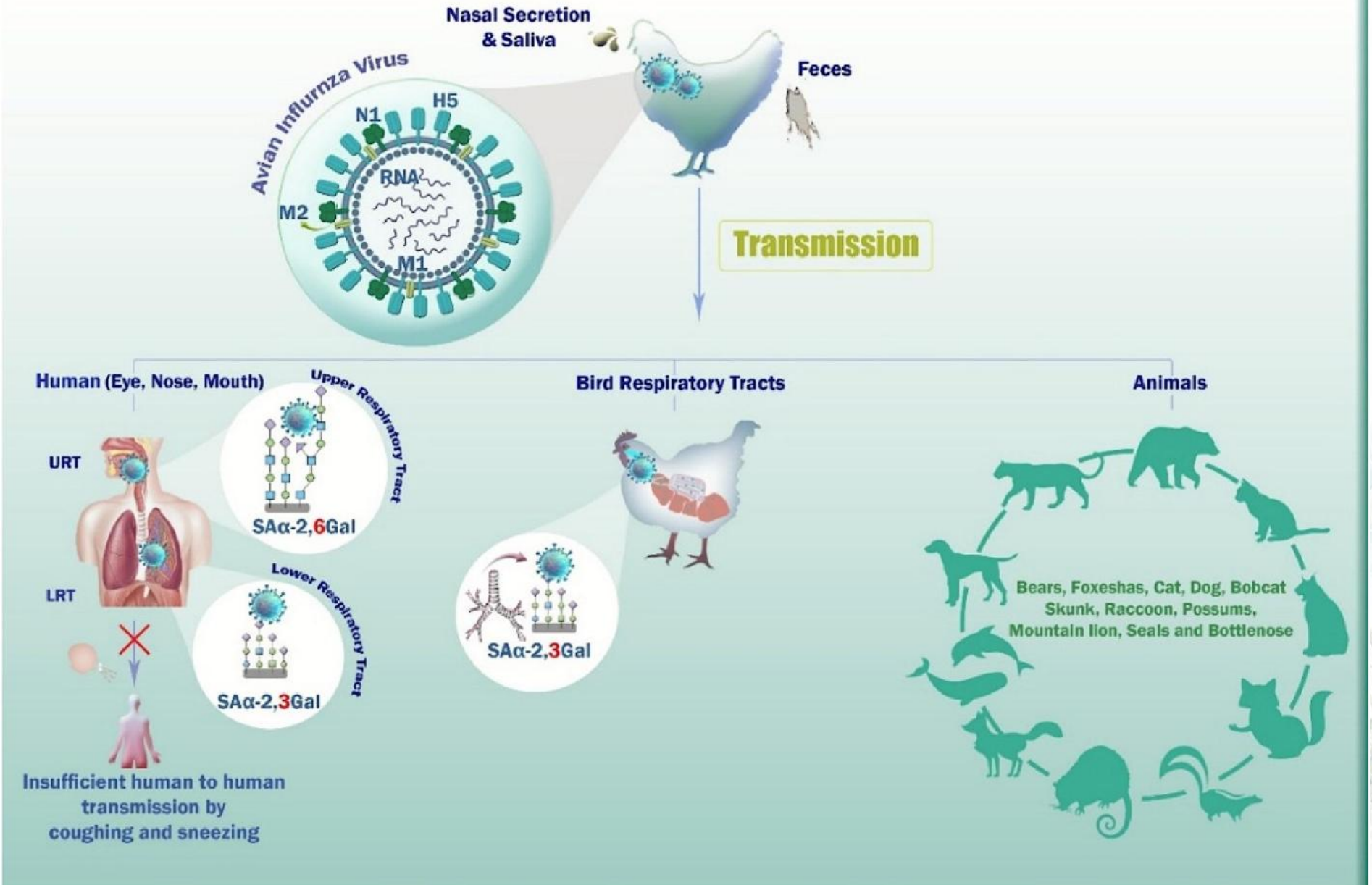
Key figures and trends

In Europe**	Outside Europe	
7 ↓	75 ↓	HPAI outbreaks in domestic birds
103 ↓	88 ≈	HPAIV detections in wild birds
4 ↓	11 ↓	HPAIV detections in wild mammals
0 ≈	76 ↑	HPAIV detections in pets, domestic and captive mammals
0	15	AI cases in humans

Sources: EFSA/ADIS/WOAH-WAHIS (birds), EFSA/WOAH/USDA (mammals), ECDC line list (humans); **as defined in Table 1 of the report



Avian influenza Klinik





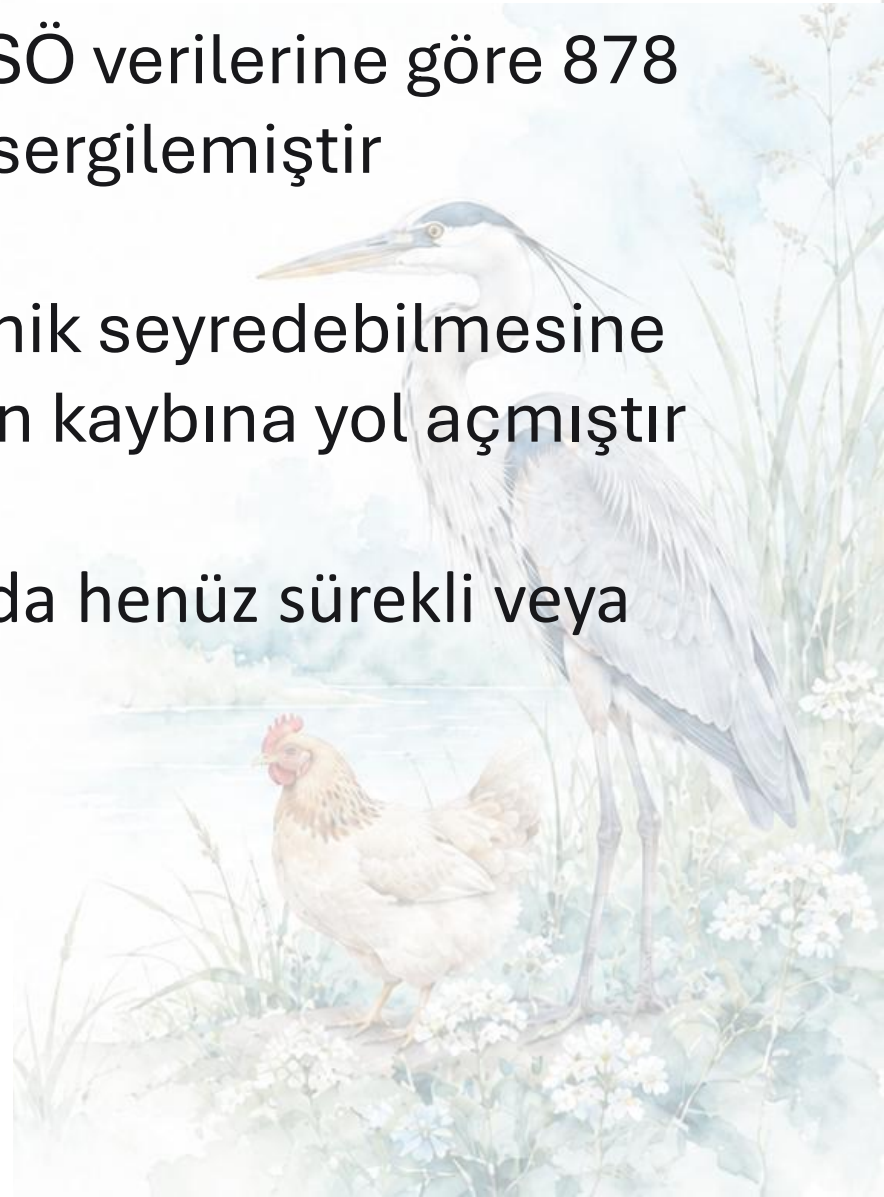
Avian influenza - Klinik

Avian influenza overview December 2024–March 2025

2025 · 43 citations · Leonidas Alexakis et al.

EFSA Journal · DOI

- **H5N1 alt tipi**, 2003'ten Temmuz 2023'e kadar DSÖ verilerine göre 878 insan vakasında **%52,16 ölüm oranı** (458 vefat) sergilemiştir
- **H7N9 suşu**, kümes hayvanlarında düşük patojenik seyredebilmesine rağmen insanlarda yaklaşık 1500 vaka ve 600 can kaybına yol açmıştır
- **İnsandan insana bulaş**, mevcut dolaşımdaki suşlarda henüz sürekli veya etkin bir biçimde tespit edilmemiştir



A comprehensive review of highly pathogenic avian influenza (HPAI) H5N1: An imminent threat...

2023 · 228 citations · Javad Charostad et al.

Travel medicine and infectious disease · DOI

Avian Influenza: Strategies to Manage an Outbreak

2023 · 50 citations · Alison Simancas-Racines et al.

Pathogens · DOI

H5N1 enfeksiyonunda klinik bulgular

İnkübasyon Ortalama 2–5 gün • Genellikle ≤7 gün

Genel belirtiler

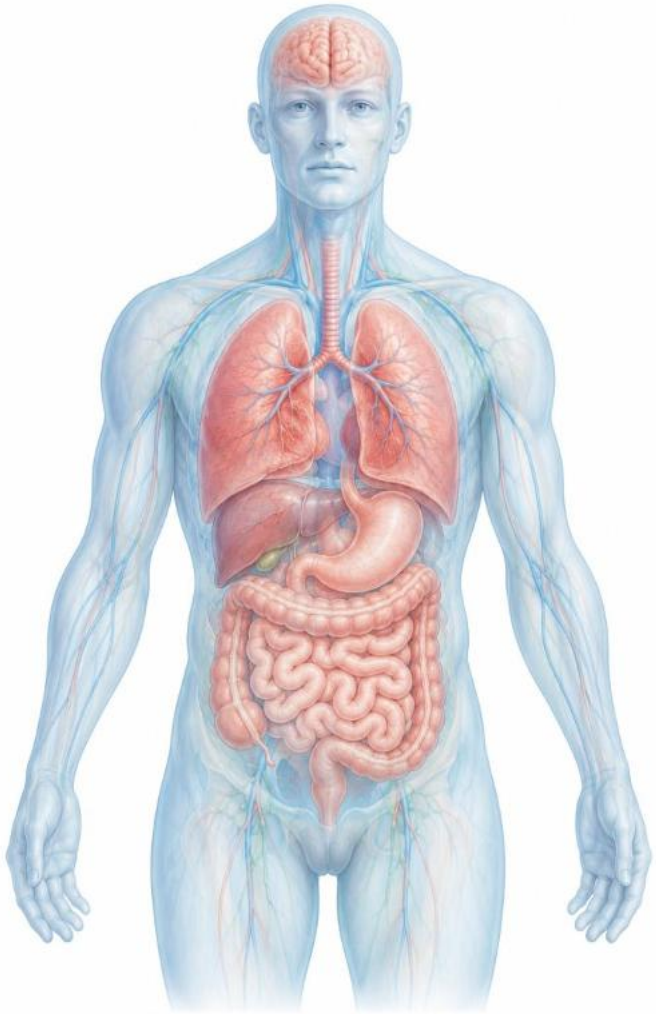
Baş ağrısı
Miyalji

Solunum belirtileri

Boğaz ağrısı
Burun akıntısı

Organ tutulumu

Akciğer
Santral sinir sistemi
Sindirim sistemi



Daha nadir

Konjonktivit
Diş eti kanaması



H5N1 enfeksiyonunda ağır hastalık



Akciğer

ARDS ve solunum yetmezliği
Pulmoner hemoraji, pnömotoraks

Diğer komplikasyonlar

Böbrek ve çoklu organ yetmezliği
Pansitopeni

Ölümle ilişkili bulgular

Yüksek viral yük
Lenfopeni

Sitokin ve kemokin düzeylerinde artış

Avian influenza salgınının etkileri

A comprehensive review of highly pathogenic avian influenza (HPAI) H5N1: An imminent threat...

2023 · 228 citations · Javad Charostad et al.

Travel medicine and infectious disease · DOI

Salgının boyutu

Tarihte kaydedilen en büyük kuş gribi salgını, kuş popülasyonları için ciddi bir tehdit oluşturuyor.

Kanatlı sektöründe kayıplar

Birkaç enfekte hayvan bile tüm sürünün itlafına ve tedarik zincirinde aksamalara yol açabiliyor.

Tüketiciye yansıyan maliyet

ABD’de tavuk eti ve yumurta fiyatlarındaki artış, salgının ekonomik etkisini ortaya koyuyor.



Konak çeşitliliği ve türler arası bulaş

A comprehensive review of highly pathogenic avian influenza (HPAI) H5N1: An imminent threat...

2023 · 228 citations · Javad Charostad et al.

Travel medicine and infectious disease · DOI

Daha geniş konak yelpazesi

Daha fazla kuş ve memeli türünün enfekte olması, virüsün dolaşımını sürdürmesini kolaylaştırıyor.

Yeni varyantların ortaya çıkma riski

Coğrafi yayılım ve yeni konaklar, bulaşıcılığı veya patojenitesi değişen varyantlara zemin hazırlıyor.

Memeliler arasında bulaş

İspanya'daki vizonlar ve Peru'daki deniz aslanları, memelilerde bulaş ve rezervuar riskini gündeme getiriyor.



Avian influenza · Klinik yaklaşım

Update and narrative review of avian influenza (H5N1) infection in adult patients

2024 · **6** citations · Mohammed Aldhaeefi et al.

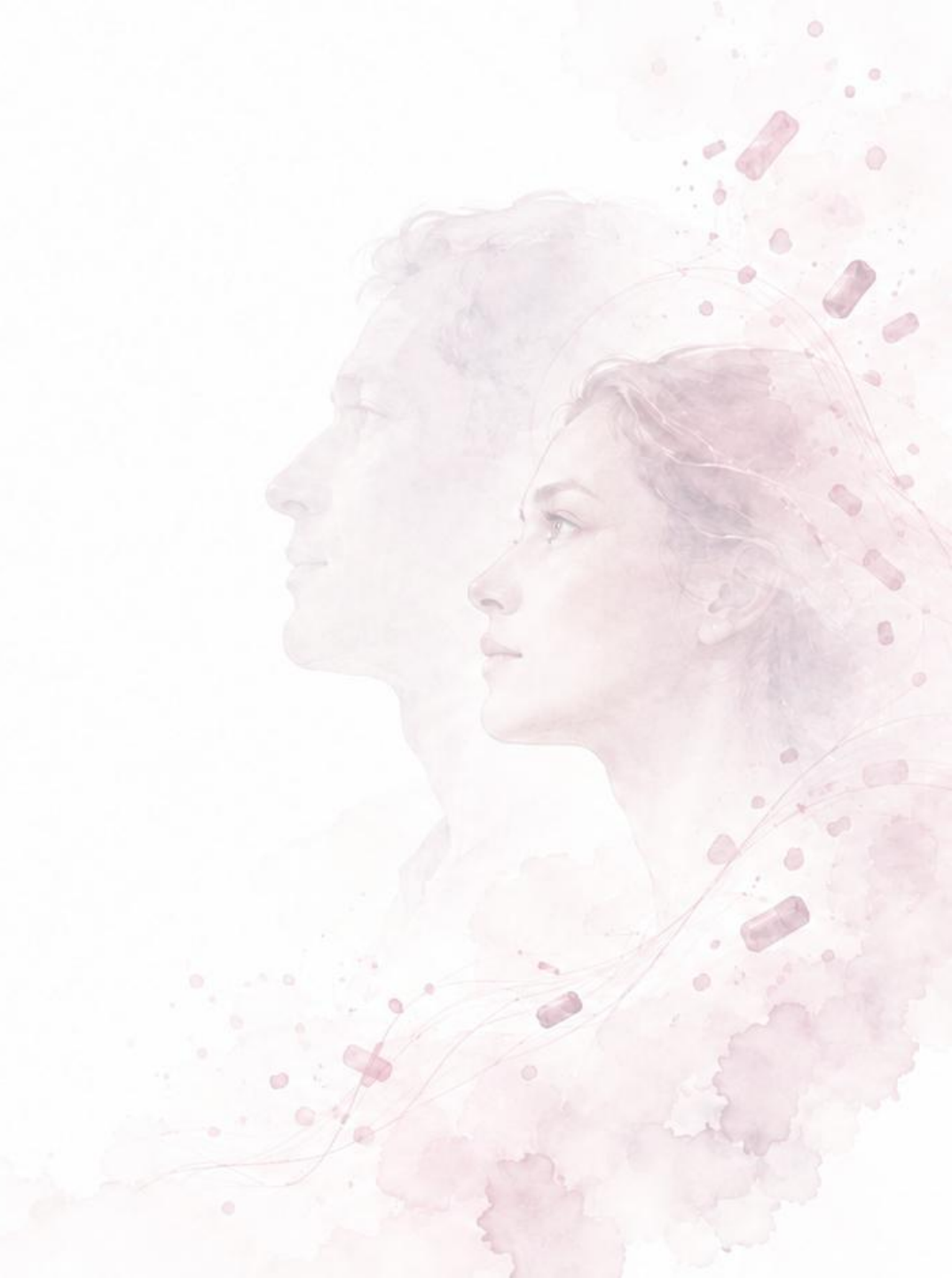
Pharmacotherapy: The Journal of Human Ph... · DOI

- Nöraminidaz inhibitörleri oseltamivir zanamivir peramivir
- Semptomların ilk 48 saati içinde önerilmektedir
- Profilakside de 7 gün veriliyor
- Amantadin, rimantadin doğal dirençli



- Kanatlılar için inaktive, mRNA, viral vektör aşıları mevcut
- 6 ay ve üzeri yaştaki kişiler için FDA tarafından onaylanmış, Audenz adlı hücre bazlı bir aşı da bulunmaktadır.

Mpox



Mpox ve küresel yayılım

Maymun çiçeği virüsü (MPXV)

Zoonotik, çift zincirli DNA virüsü, *Orthopoxvirus*, *Poxviridae*

Çiçek hastalığına benzer döküntüler ve sistemik bulgular
Clade I ve II

2022 öncesi

Çoğunlukla
Orta ve Batı Afrika

2022

Küresel yayılım
Clade IIb

23 Temmuz 2022

Uluslararası öneme sahip halk sağlığı acil durumu ilanı

Mpox · Tarihçe ve rezervuar

1958

Danimarka’da araştırma maymunlarında ilk kez tespit edildi

1970

İnsanda ilk vaka, Kongo Demokratik Cumhuriyeti

Doğal rezervuar

Kesin olarak aydınlatılamadı; Afrika’daki kemirgenlerin ana konak olduğu düşünülüyor

Virüs saptanan küçük memeliler

- İp sincapları
- Ağaç sincapları
- Gambiya keseli sıçanı

The changing epidemiology of human monkeypox —A potential threat? A systematic review

2021 · **1652** citations · E. Bunge et al.

PLoS Neglected Tropical Diseases · DOI



Monkeypox: epidemiology, pathogenesis, treatment and prevention

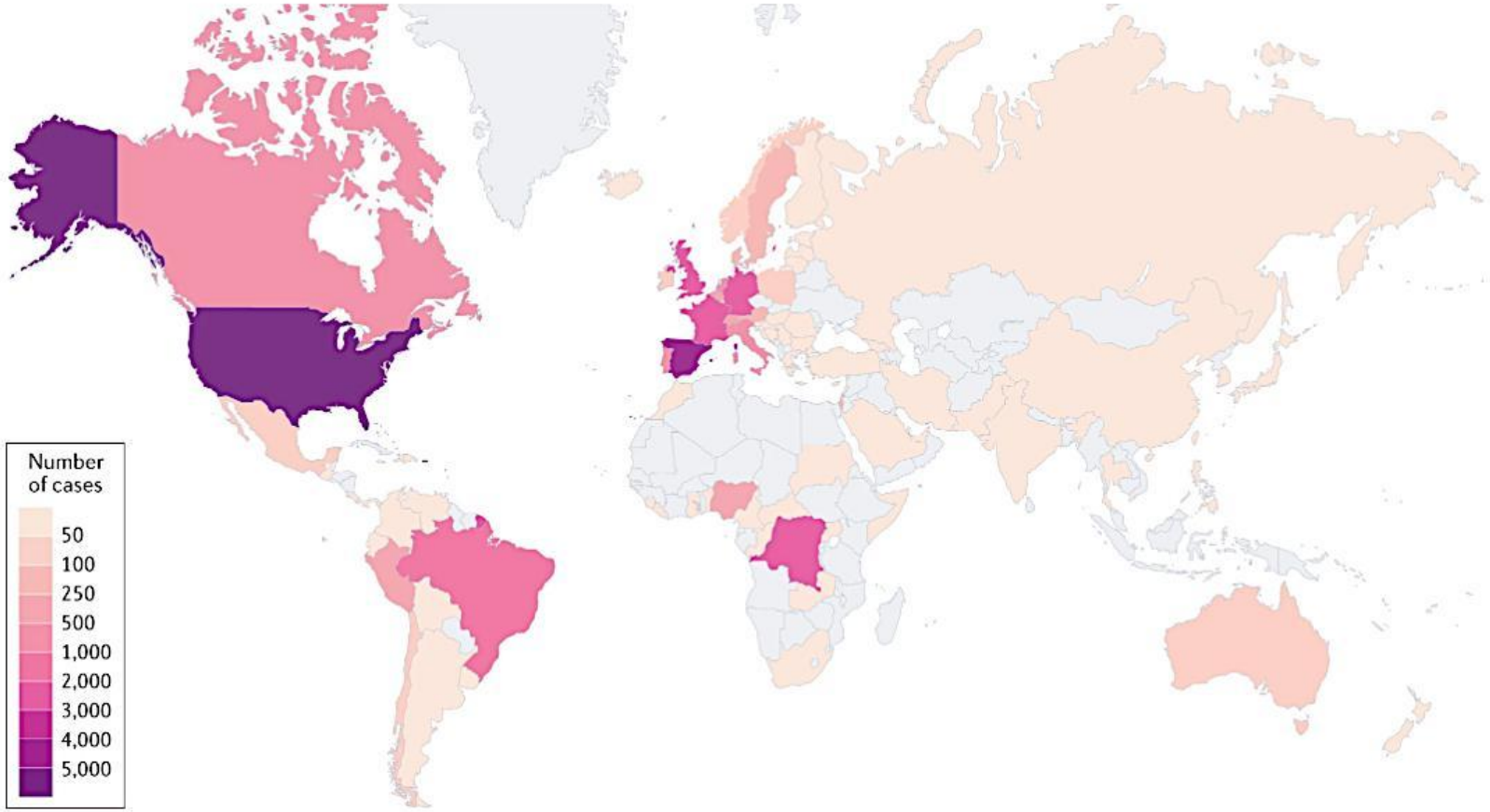
2022 · **259** citations · Yong Huang et al.

Signal Transduction and Targeted Therapy · DOI

Mpox-Epidemiyoloji

Fig. 1: Geographical distribution of confirmed and suspected monkeypox cases during the outbreak between May and August 2022.

From: Monkeypox: disease epidemiology, host immunity and clinical interventions



Data presented as of 5 August 2022 were obtained from Global.health. Diagram generated with Datawrapper.

Back to article page ›



Monkeypox: disease epidemiology, host immunity and clinical interventions

2022 · **421** citations · F. Lum et al.

Nature Reviews. Immunology · DOI ↗

Mpox Outbreak Mapping

The following resources provide data mapped on Mpox cases. (Sources: WHO / Our World in Data)



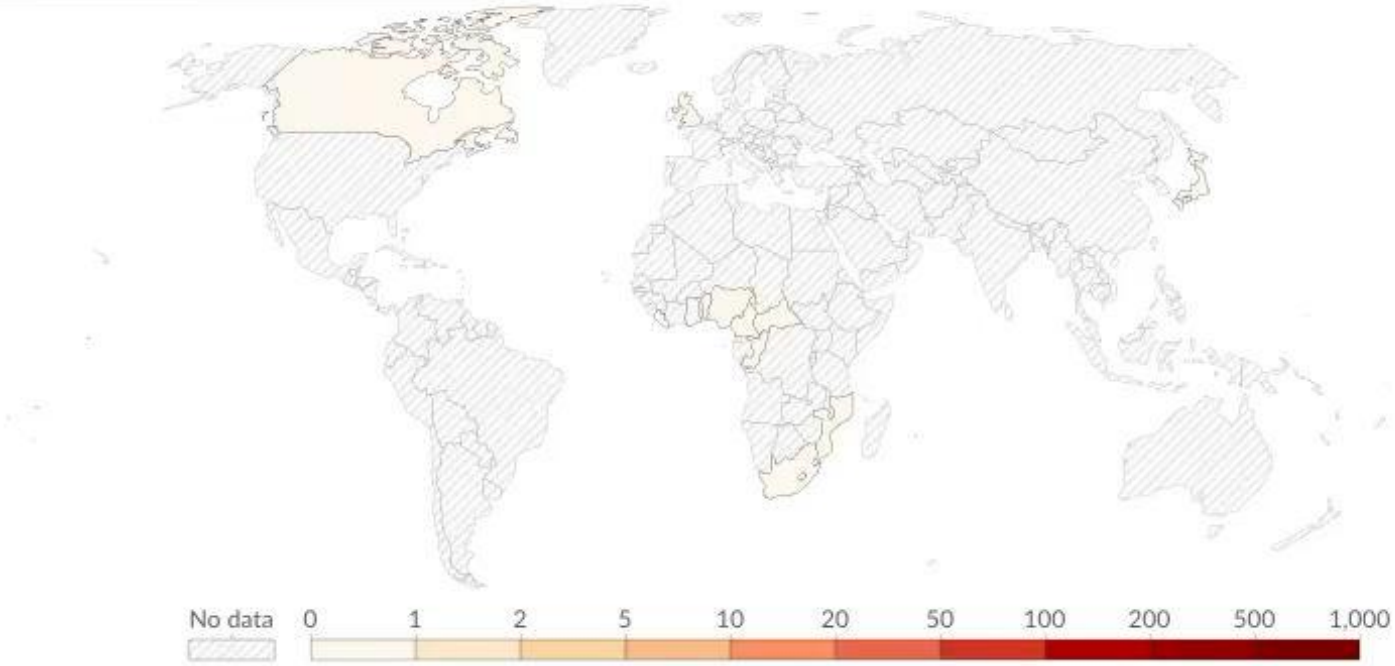
Mpox: Daily confirmed cases May 1, 2022

Our World in Data

7-day rolling average. Laboratory testing for mpox is limited in many countries and figures shown here only include laboratory-confirmed cases.

Table | Map | Line | Bar

Select countries



May 1, 2022 — Apr 30, 2026

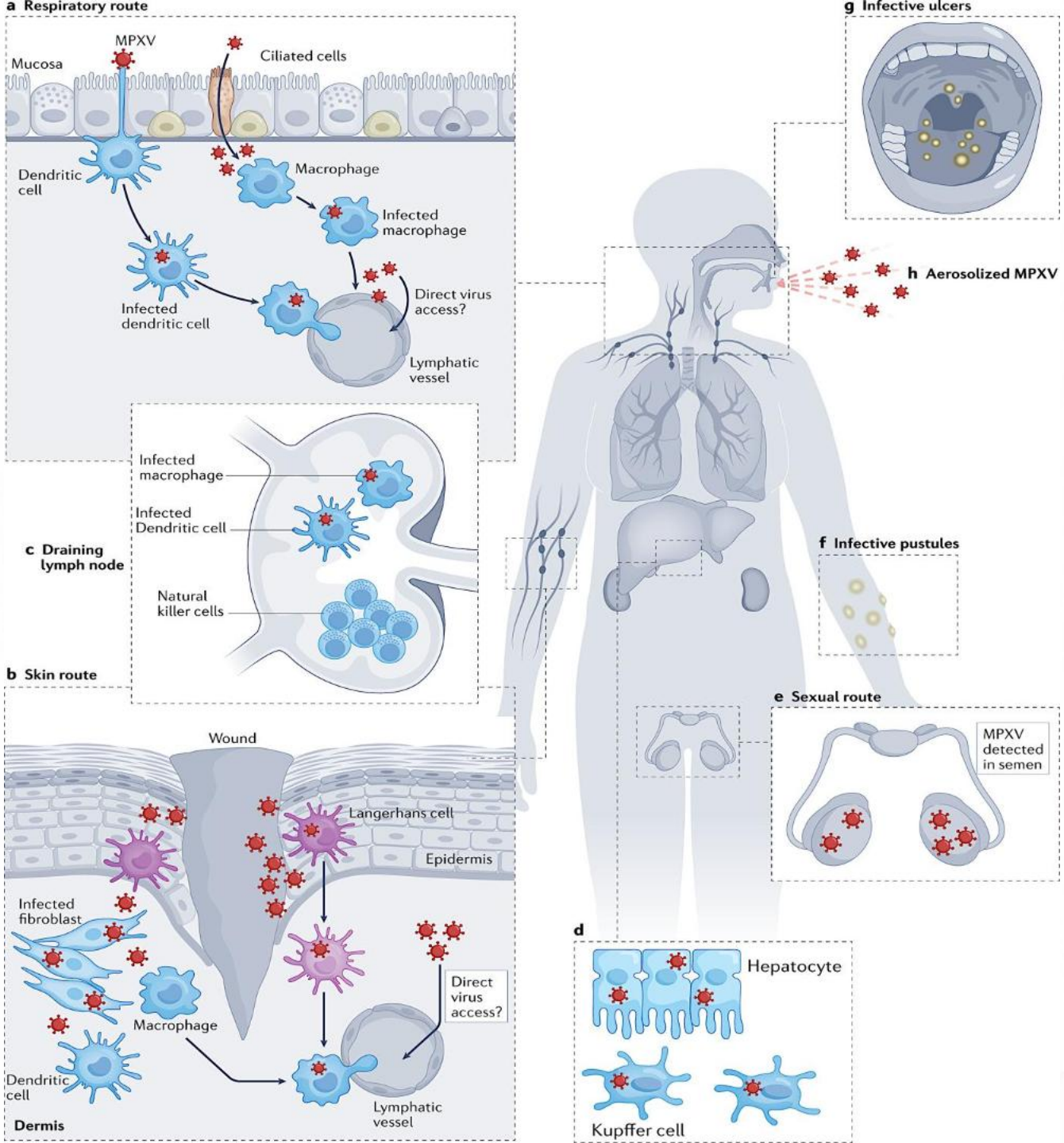
Data source: World Health Organization; World Health Organization (2024) – Learn more about this data
Note: Where data is unavailable, the closest value within 7 days is shown instead.
CC BY

Explore the data →



Mpox Epidemiyoloji

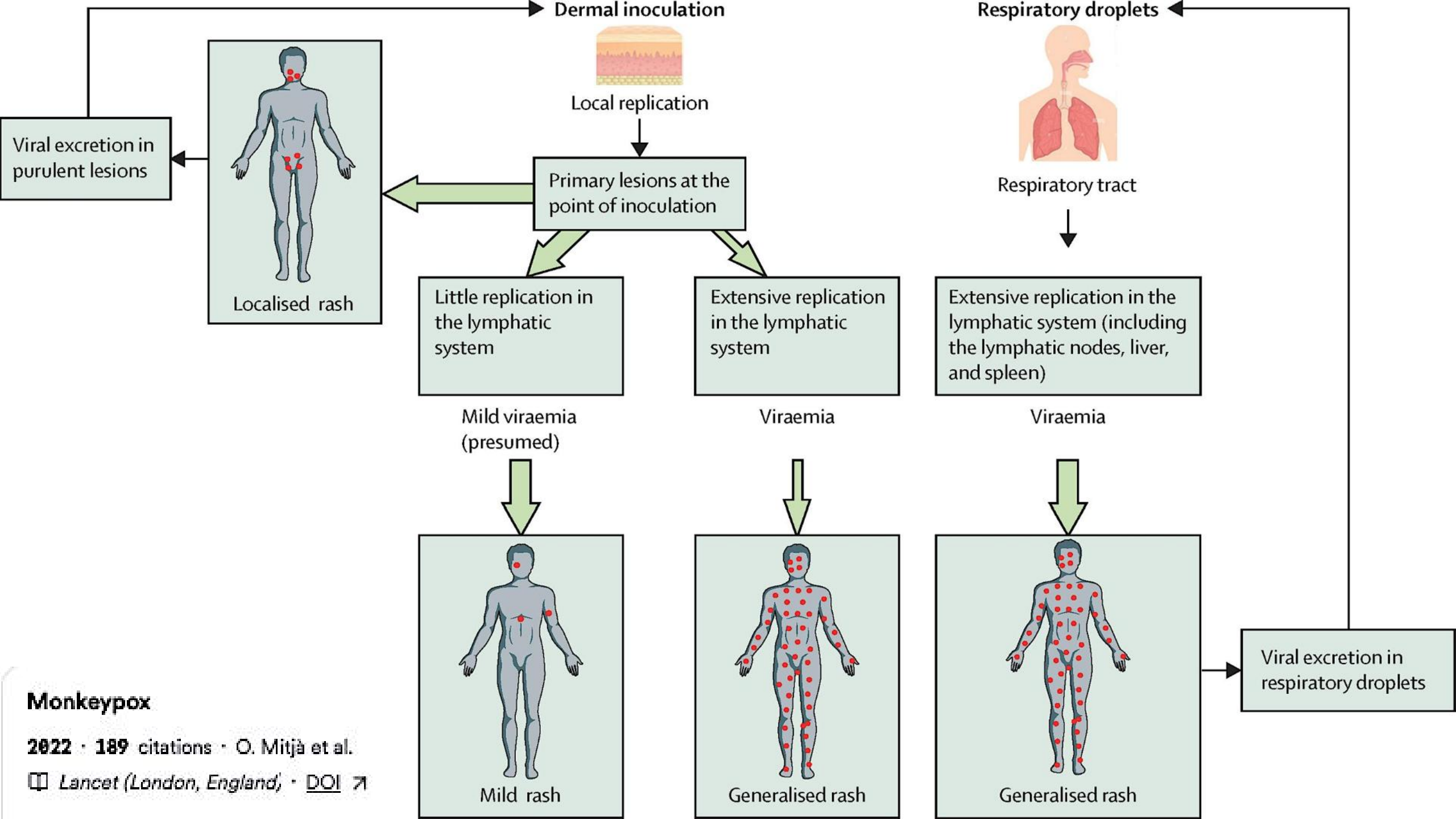
Mpox-Patogenez



Monkeypox: disease epidemiology, host immunity and clinical interventions

2022 · **421** citations · F. Lum et al.

Nature Reviews. Immunology · DOI ↗



Monkeypox

2022 · **189** citations · O. Mitjà et al.

Lancet (London, England) · DOI

Mpox – Klinik

- Kuluçka süresi 6-13 gün, 21 güne kadar uzayabilir
- Semptomlar 2-4 hafta sürüyor
- Ateş
- LAP
- Başağrısı

- Papül
- Makül
- Vezikül
- Püstül
- Ağrılı



Mpox - Klinik










CDC Monkeypox
EXPLORE THIS TOPIC

Mpox - Klinik





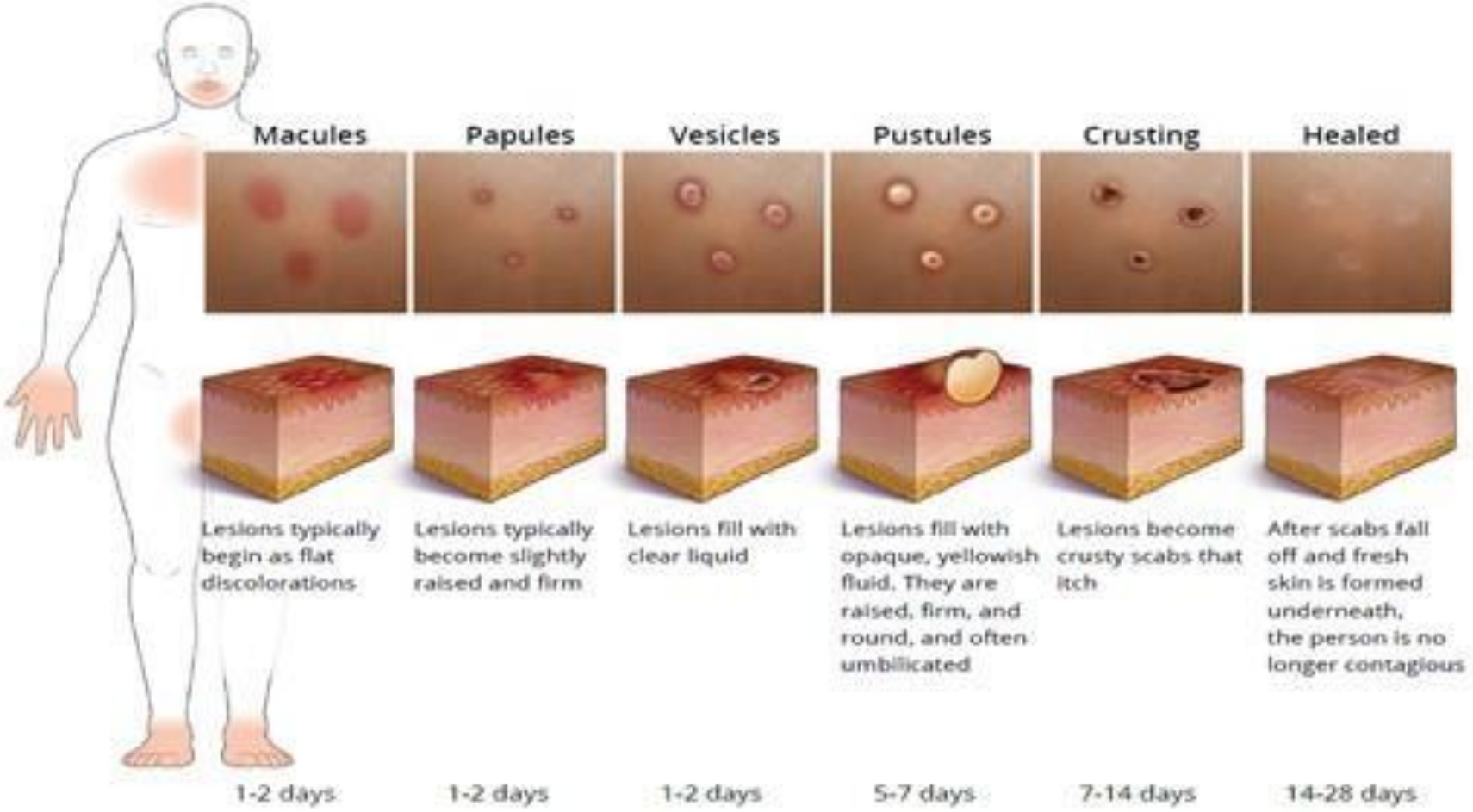




Monkeypox lesions typically develop at the same time and evolve together on any given part of the body.

CDC Monkeypox
EXPLORE THIS TOPIC

Mpox - Klinik



CDC Monkeypox
EXPLORE THIS TOPIC

Mpox - Komplikasyonlar

- Bakteriyel süperinfeksiyon %40-58
- Proktit/anal ağrı %28
- Konjonktivit %7 Keratit %3.4
- Pnömoni (%2.2)
- Ensefalit (%0.2)
- Sepsis, Aby, miyokardit

Global complications among patients with mpox: a systematic review and meta-analysis

2026 · **0** citations · Ya Gao et al.

eClinicalMedicine · DOI



Clinical features and management of individuals admitted to hospital with monkeypox and...

2022 · **76** citations · Douglas L. Fink et al.

The Lancet. Infectious diseases · DOI

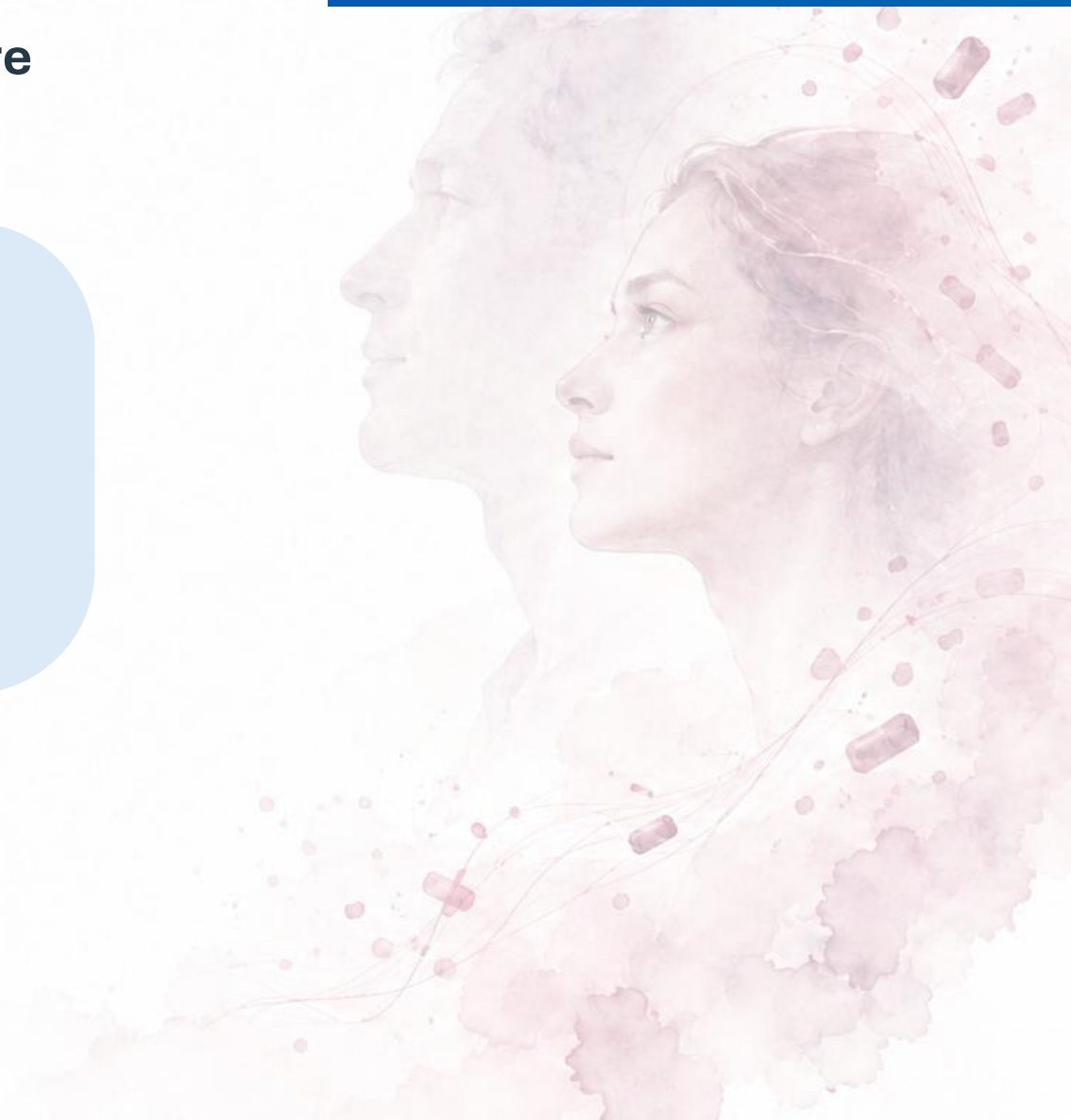
Mpox · Mortalite

CDC Monkeypox
EXPLORE THIS TOPIC

Son salgınlarda ölüm oranları düşük ve klada göre değişiyor

~%3	< %0,5	< %0,1
Klad Ia	**Klad Ib**	**Klad II**
En yüksek oran	Son salgınlarda	2022 salgını

Klad II enfeksiyonu olanların binde birinden azı hastalık nedeniyle kaybediliyor.



Mpox · Aşı

CDC Monkeypox
EXPLORE THIS TOPIC

- Cinsel risk faktörü olan,
- Risk altındakiler, klad ne olursa olsun,
- ideal olarak maruziyetten önce aşılanmalı;
- Maruziyet sonrası profilaksi de uygulanabilir



JYNNEOS sc

FDA onaylı

Mpox ve çiçek için CDC ve ACIP önerisi

Ticari olarak erişilebilir

ACAM2000

FDA onaylı (çiçek ve MPXV)

ABD'de stoku bol

Yan etki ve kontrendikasyonları daha fazla

Mpox · Antiviral tedavi

Ajan	Etki mekanizması	Klinik kanıt ve uyarılar
Tecovirimat (TPOXX)	Viral VP37 protein inhibisyonu	RCT'de lezyon süresini kısaltmadı; Direnç mutasyonları bildirildi
Brincidofovir	Viral DNA polimeraz inhibisyonu	Oral lipid ön-ilaç; karaciğer enzim yüksekliği yapabilir

Placebo-Controlled Trial of Tecovirimat for Endemic (Clade I MPXV) mpox, DRC

2025 · **57** citations · Rosine Ali et al.

The New England journal of medicine · DOI



Brincidofovir in the Era of Mpox

2025 · **9** citations · James McCarty et al.

Expert Review of Anti-infective Therapy · DOI

Systematic Review

MERS-CoV



MERS-CoV

Ortadoğu Solunum Sendromu Koronavirüsü

İnsanlarda ciddi alt solunum yolu enfeksiyonuna yol açabilen, ölümcül zoonotik bir patojen

2012 Suudi Arabistan'da ilk kez tanımlandı

~%35 Vaka ölüm oranı

DSÖ Öncelikli küresel tehditler arasında



MERS-CoV · Virüsün özellikleri

Sınıflandırma

Coronaviridae › **Betakoronavirüs** › **Lineage C**

Genom

RNA
Tek sarmallı

(+)
Pozitif polariteli

~30 kb
Genom büyüklüğü



MERS-CoV · Rezervuar ve bulaş

Doğal rezervuar ve konak

Tek hörgüçlü develer

Birincil zoonotik konak

Bulaş yolları

Deveden insana

Enfekte develerle doğrudan temas

İnsandan insana

Nozokomiyal, damlacık yoluyla

SARS and MERS: recent insights into emerging coronaviruses

2016 · **3347** citations · E. de Wit et al.

Nature Reviews. Microbiology · DOI

Middle East Respiratory Syndrome Coronavirus (MERS-CoV): Infection, Immunological Respons...

2019 · **183** citations · A. Mubarak et al.

Journal of Immunology Research · DOI

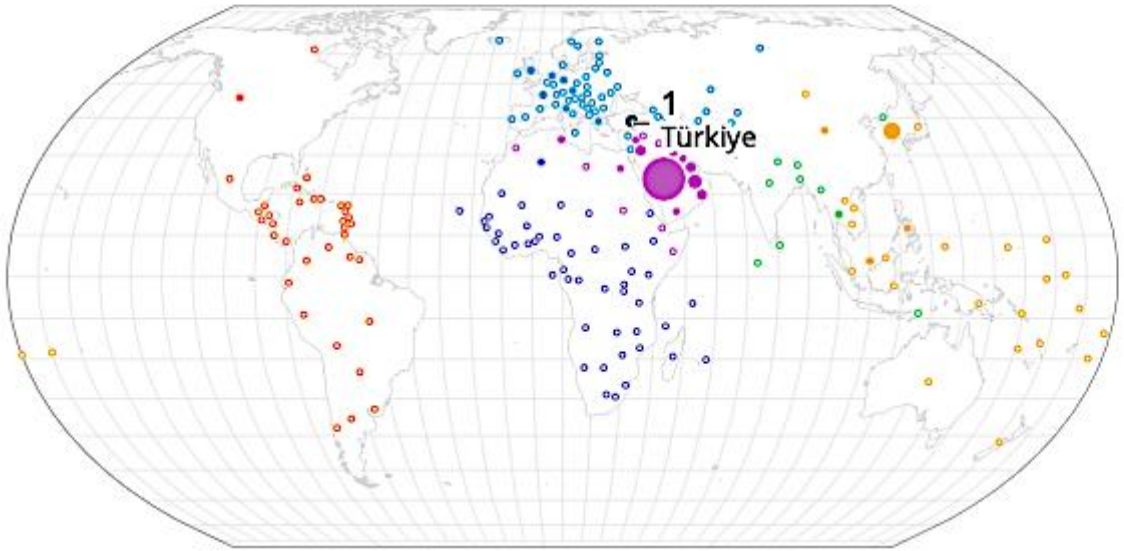


MERS-CoV · Epidemiyoloji

World Health Organization
Data

Number of MERS cases reported to WHO (cumulative total)

Cumulative number of reported cases globally since 2012 (as of the most recent data update)



WHO Regions

Africa · Americas · Eastern Mediterranean · Europe · South-East Asia · Western Pacific

Note: *Countries not included in the list have not reported data or have no information available.*

2,637

Cumulative number of reported cases globally since 2012 (as of the most recent data update)

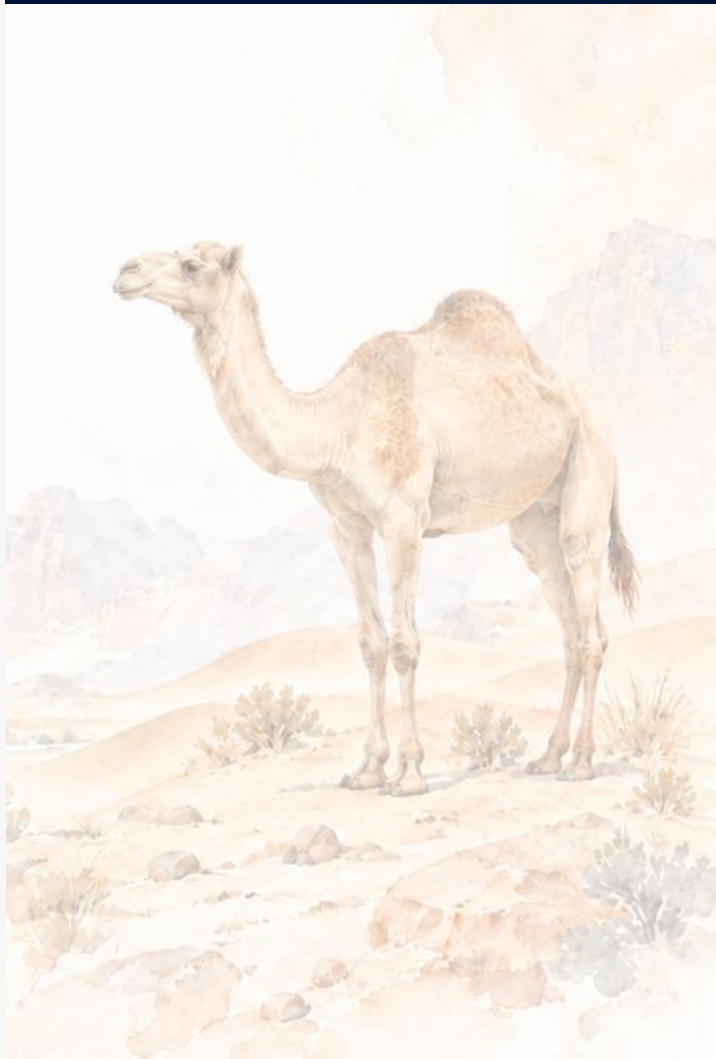
Number of MERS cases reported to WHO (cumulative total)

Cumulative number of reported cases globally since 2012 (as of the most recent data update)

	Number of cases
Saudi Arabia	2.2k
Republic of Korea	186
United Arab Emirates	94

Show 191 more

Middle East respiratory syndrome coronavirus (MERS-CoV) Dashboard



MERS-CoV · Epidemiyoloji

World Health Organization
Data

Middle East respiratory syndrome coronavirus (MERS-CoV) Dashboard

Admission to Hospital and Intensive Care Unit (ICU)

Cumulative number of reported cases globally since 2012 (as of the most recent data update)

	Number of cases
Hospitalization	2.4k
ICU	870
Not reported	68

Occupation

Cumulative number of reported cases globally since 2012 (as of the most recent data update)

	Number of cases
Healthcare worker	440
Working with camels	24
Other	1.8k
Not reported	351



MERS-CoV · İmmünopatogenez

SARS-CoV'dan farklı olarak

T hücre enfeksiyonu

CD26'yı yüksek düzeyde eksprese eden CD4+ ve CD8+ T hücreleri doğrudan enfekte olur

▼

Kaspaz aktivasyonu

İntrinsik ve ekstrinsik kaspaz yolları devreye girer

▼

Sonuç

T lenfosit apoptozu ve belirgin immün disregülasyon

Middle East respiratory syndrome coronavirus (MERS-CoV): A review.

2019 · **180** citations · N. Ramadan et al.

Germs · DOI ↗

Middle East Respiratory Syndrome Coronavirus (MERS-CoV): Infection, Immunological Respons...

2019 · **183** citations · A. Mubarak et al.

Journal of Immunology Research · DOI ↗



MERS-CoV · Doku hasarı

Doku hasarını artıran yanıtlar

Gecikmiş tip I IFN

IFN-α/β yanıtı geç başlar

Yüksek IL-17

Proinflamatuar sitokin salınımı artar

Etkilenen dokular

- **Solunum epiteli**
- **Böbrek tübüler hücreleri**
- **Karaciğer**
- **Bağırsak**

Middle East respiratory syndrome coronavirus (MERS-CoV): A review.

2019 · **180** citations · N. Ramadan et al.

Germs · DOI ↗

Middle East Respiratory Syndrome Coronavirus (MERS-CoV): Infection, Immunological Respons...

2019 · **183** citations · A. Mubarak et al.

Journal of Immunology Research · DOI ↗



MERS-CoV · Klinik

Middle East Respiratory Syndrome Coronavirus (MERS-CoV) infection: epidemiology,...

2018 · 123 citations · M. Nassar et al.

European review for medical and pharmacol... · DOI

Semptomlar

- Ateş
- Öksürük
- Nefes darlığı
- Miyalji
- Diyare ve diğer GİS bulguları

Olumsuz seyir için yüksek risk

- İleri yaş
- Erkek cinsiyet
- Diyabet
- Kronik böbrek yetmezliği
- Malignite



MERS-CoV · Tanı

Kesin tanı

RT-PCR

Laboratuvar

- **Lenfopeni**
- **Trombositopeni**

Görüntüleme

- **Akciğerde buzlu cam opasiteleri**

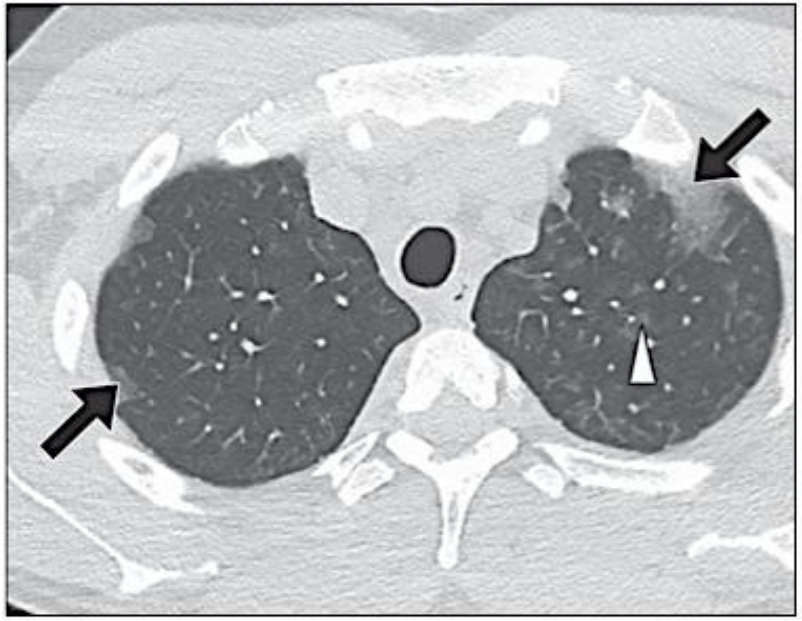
MERS-CoV: Understanding the Latest Human Coronavirus Threat

2018 · 244 citations · A. Chafekar et al.

Viruses · DOI



MERS-CoV-Akciğer görüntüleri



A



B



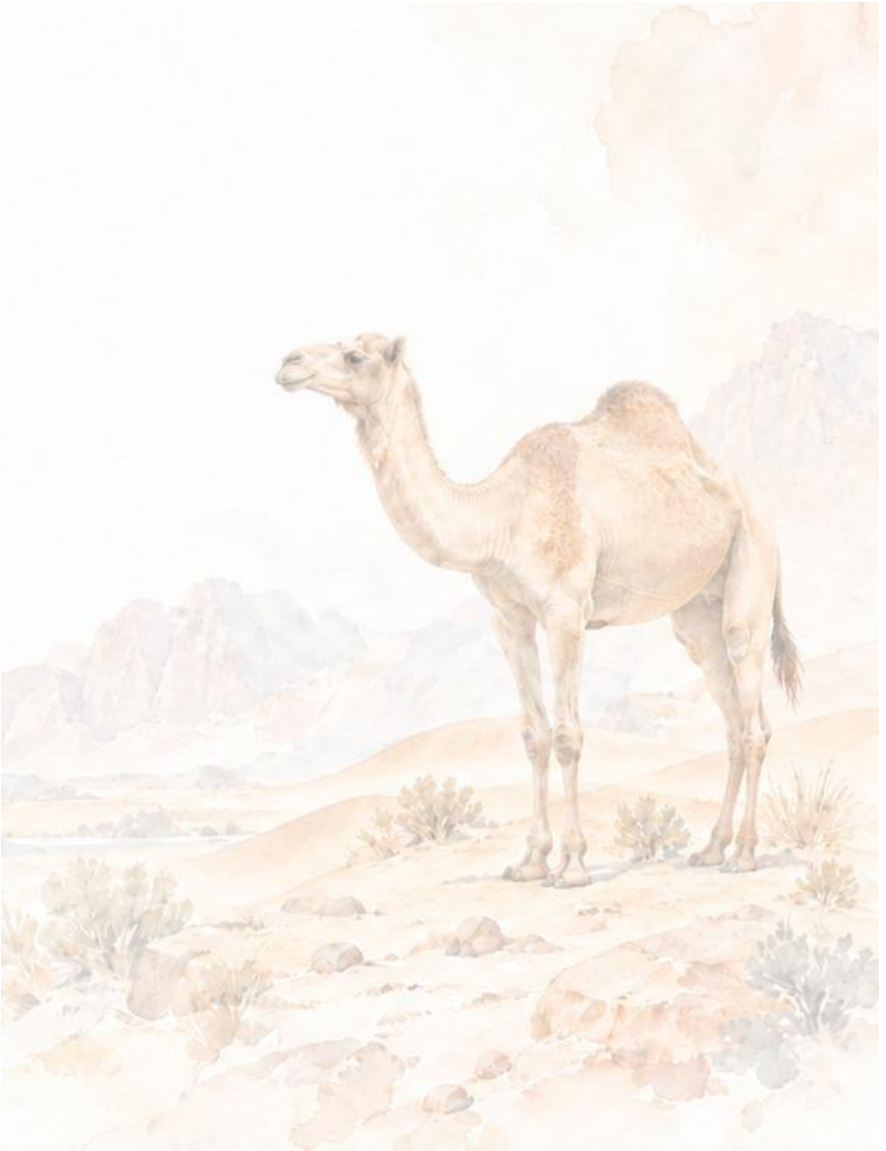
C

Fig. 1—27-year-old man with Middle East respiratory syndrome (case 1). Patient was smoker who was healthy otherwise. CT was performed 8 days after admission and 20 days after onset of symptoms. Patient was eventually discharged.
A, Upper lung CT image shows bilateral subpleural ground-glass opacities (*arrows*) and ill-defined centrilobular ground-glass nodules (*arrowhead*).
B and **C,** Two lower lung CT images show large right lower lobe (*arrow*, **B**) and small focal left lower lobe (*arrow*, **C**) subpleural consolidations.

Middle East respiratory syndrome coronavirus (MERS-CoV) infection: chest CT findings.

2014 · **295** citations · A. Ajlan et al.

AJR. American journal of roentgenology · DOI



MERS-CoV-Akciğer görüntüleri

Middle East respiratory syndrome coronavirus (MERS-CoV) infection: chest CT findings.

2014 · **295** citations · A. Ajlan et al.

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A

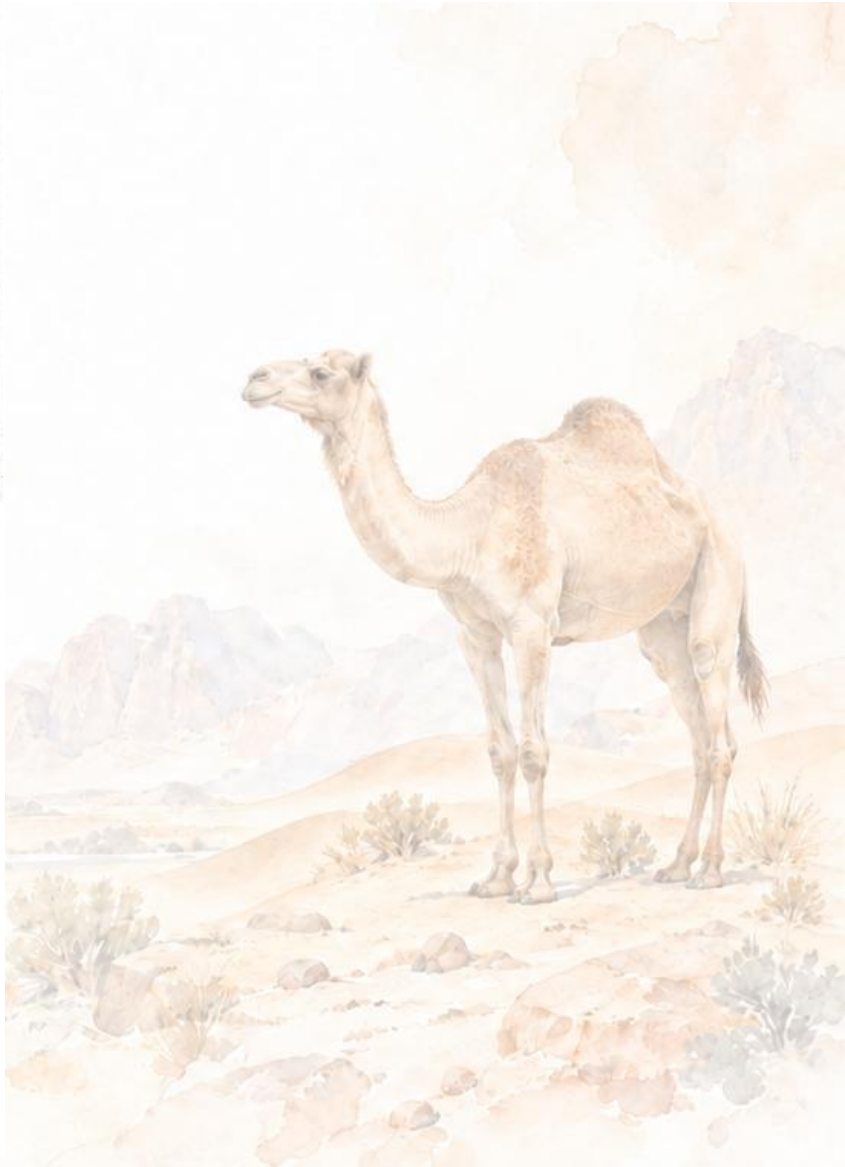


B



C

Fig. 3—50-year-old woman with Middle East respiratory syndrome (case 3). Patient had history of diabetes, hypertension, and chemotherapy-induced cardiomyopathy. CT was performed 19 days after admission and 22 days after onset of symptoms. Patient was eventually discharged.
A, Upper lung CT image shows minimal reticulation (*arrow*) and large areas of bilateral ground-glass opacities and consolidation.
B, Mid-lung CT image shows minimal reticulation (*arrow*), perilobular opacities (*arrowhead*), and extensive ground-glass opacities and consolidation.
C, Lower lung CT image shows traction bronchiectasis (*arrow*) and large areas of bilateral ground-glass opacities and consolidation.

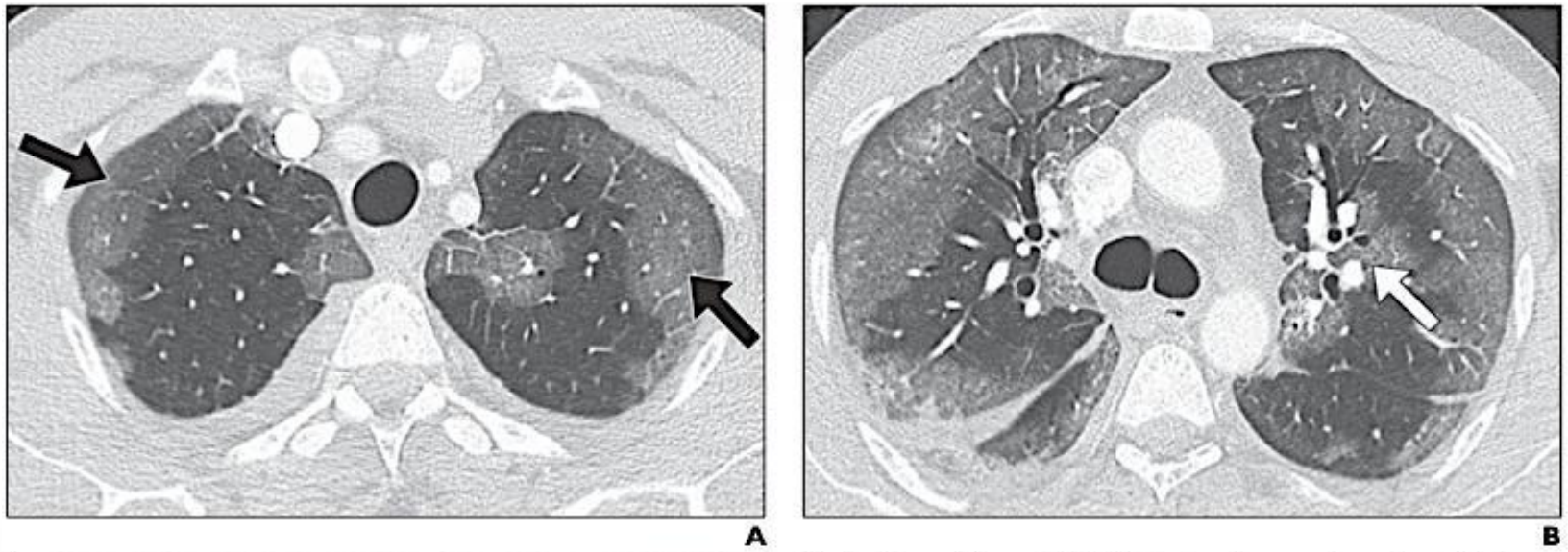


MERS-CoV-Akciğer görüntüleri

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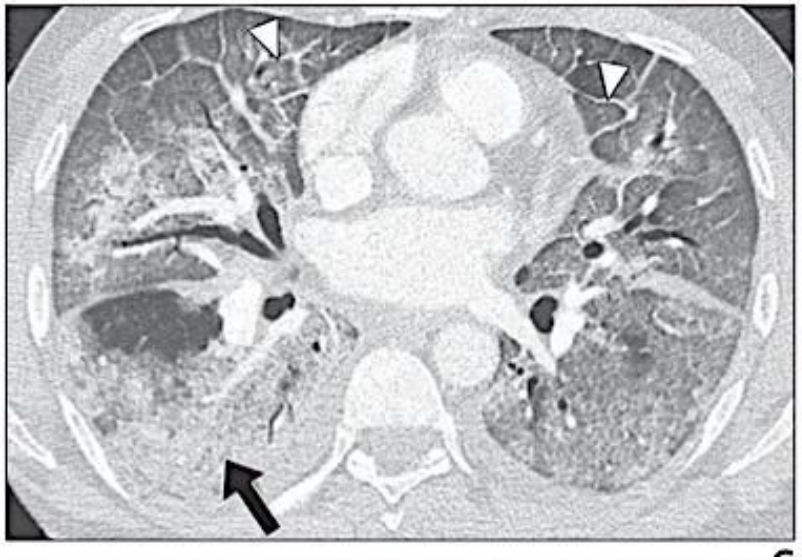
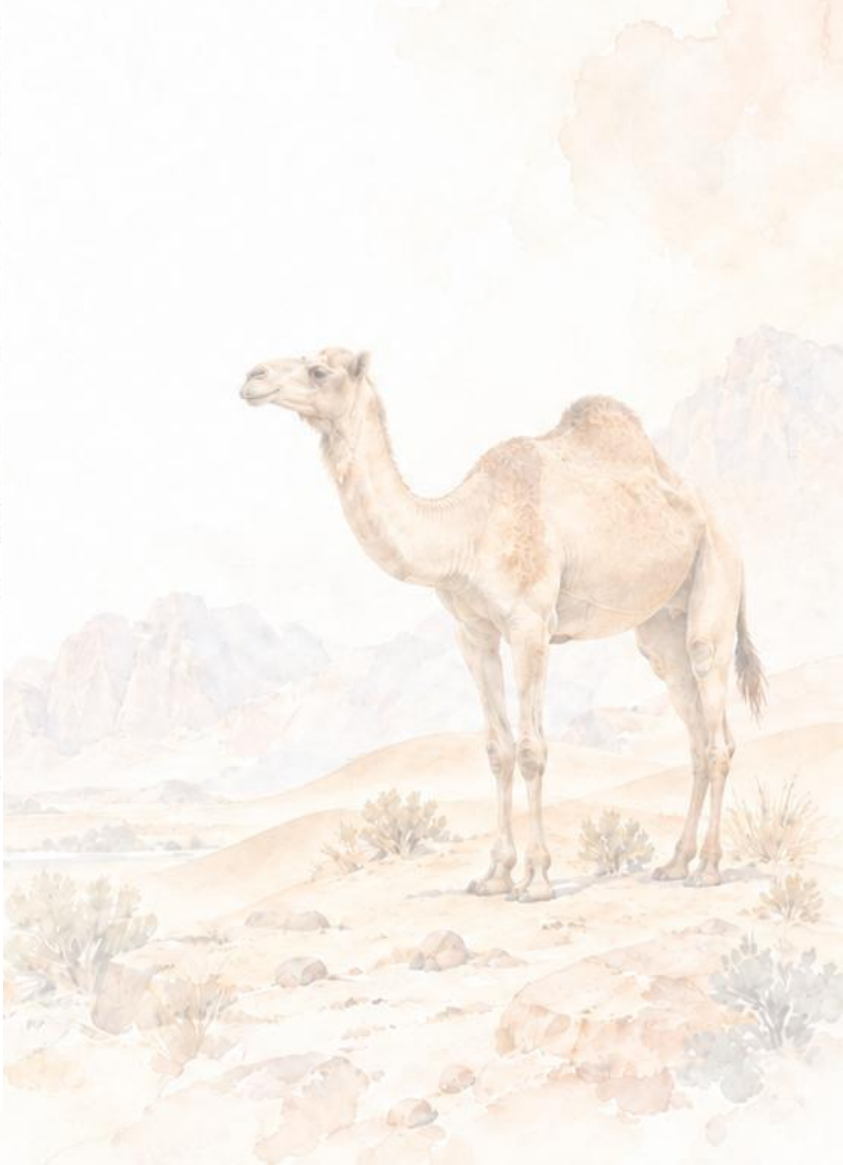


Fig. 4—44-year-old man with Middle East respiratory syndrome (case 4). Patient had no prior health problems. CT was performed 1 day after admission, which was 9 days after onset of symptoms. Patient died in ICU.
A, Upper lung CT image shows large areas of bilateral subpleural ground-glass opacities (*arrows*).
B, Mid-lung CT image shows that ground-glass opacities have peribronchovascular distribution as well (*arrow*).
C, Lower lung CT image shows more extensive and confluent basal abnormalities, with right lower lobe consolidation (*arrow*) and bilateral smooth interlobular septal thickening (*arrowheads*).



MERS-CoV · Klinik yaklaşım

MERS-CoV enfeksiyonuna yönelik

Resmi onay almış spesifik bir

A**ntiviral ilaç veya lisanslı aşı** bulunmamaktadır



Akılda kalacak mesajlar

Avian influenza

H5N1 insanda ölümcül olabilir; şüphede ilk 48 saatte antiviral başlanmalı.

Mpox

2022'den beri küresel yayılan klad II’de ölüm oranı düşük
Risk altındakiler maruziyetten önce aşılanmalı.

MERS-CoV

Develerden bulaşan MERS-CoV’da ölüm oranı ~%35
Onaylı antiviral ve aşı olmadığından korunma esastır.



İlginiz için teşekkür ederim

