

## The Auror's Watch

## **Emergent Pathogens and Pathogens to Watch**



## Allen Bateman, PhD, D(ABMM) Director, Communicable Disease Division Wisconsin State Laboratory of Hygiene



# Outline



- Useful resources
- Short history of Emerging Infectious Diseases (EID)
  - Origin of term
  - All-hazards preparedness
  - LRN and WCLN
- Recent emerging diseases and outbreaks
- Identifying new pathogens by metagenomic sequencing









## Pro-MED Mail

- Free!
- Website and/or emails
- Invaluable and timely

#### https://promedmail.org/



Carl Reply All Carl Forward

Fri 9/15/2023 5:58 PM

#### ProMED <promed@isid.org>

PRO/AH/EDR> Nipah virus - India (05): (KL) 6 total cases, 1080 contacts

To Bateman, Allen

f) Click here to download pictures. To help protect your privacy, Outlook prevented automatic download of some pictures in this message.

#### NIPAH VIRUS - INDIA (05): (KERALA) 6 TOTAL CASES, 1080 CONTACTS, 297 HIGH RISK

A ProMED-mail post <u>http://www.promedmail.org</u> ProMED-mail is a program of the International Society for Infectious Diseases <u>http://www.isid.org</u>

Date: Sat 16 Sep 2023 00:05 IST Source: Hindustan Times [edited] https://www.hindustantimes.com/india-news/in-kerala-1-more-tests-positive-for-nipah-tally-at-6-101694802929712.html



Sat 9/9/2023 10:25 AM

### ProMED <promed@isid.org>

PRO/AH/EDR> Pneumovirus - USA: (FL) dog, animal shelter

To Bateman, Allen

## PNEUMOVIRUS - USA: (FLORIDA) DOG, ANIMAL SHELTER

A ProMED-mail post <u>http://www.promedmail.org</u> ProMED-mail is a program of the International Society for Infectious Diseases <u>http://www.isid.org</u>

Date: Fri 8 Sep 2023 16:37 EDT Source: WFTV 9 [edited] https://www.wftv.com/news/local/kennel-cough-outbreak-forces-orange-county

Orange County Animal Services has suspended intakes of dogs after animals at the facility contracted pneumovirus, commonly known as "kennel cough." The highly contagious respiratory virus has symptoms of coughing, sneezing and nasal discharge. It can become serious, leading to pneumonia and difficulty breathing.



#### Communicated by: ProMED

[Pneumoviruses cause disease in a variety of species (RSV in humans, cattle, sheep, and goats; human and avian metapneumoviruses; and pneumonia virus of mice). In dogs, pneumoviruses can be a component of the canine infectious respiratory disease (CIRD) complex. CIRD often displays as a mixed viral and bacterial infection that may include one or more of the following: canine influenza, canine adenovirus, canine respiratory coronavirus, canine parainfluenza, pneumovirus, Bordetella, Mycoplasma, Strep. zoo., etc. CIRD is very difficult to control in a shelter setting because of the constant inflow of new, naive dogs into the population. Once an outbreak is underway, the most effective management involves closing the shelter to new introductions until the shedding period has ended for the underlying pathogen(s). which can be several weeks in some cases. Vaccination against one or more of the causative pathogens can help prevent severe disease in dogs being kenneled but isn't effective in most shelters because the dog would need be to be vaccinated several weeks before entry into the shelter to have sufficient immunity (and that's assuming the CIRD pathogen(s) causing the outbreak have an available vaccine). - Mod.JH



## CDC's MMWR

Morbidity and Mortality Weekly Report

Health Care Provider Knowledge and Attitudes Regarding Adult Pneumococcal Conjugate Vaccine Recommendations — United States, September 28–October 10, 2022

Progress Toward Measles Elimination — African Region, 2017–2021

Morbidity and Mortality Weekly Report

Reduced Odds of Mpox-Associated Hospitalization Among Persons Who Received JYNNEOS Vaccine — California, May 2022–May 2023

https://www.cdc.gov/mmwr/index.html



Notes from the Field

Gastrointestinal Illness Among Hikers on the Pacific Crest Trail — Washington, August–October 2022

https://www.cdc.gov/mmwr/index.html



## Emerging Infectious Diseases journal

- Not as immediate, but more in-depth articles
- Interesting pictures on the cover!



https://wwwnc.cdc.gov/eid/



#### Outbreak of NDM-1- and OXA-181-Producing Klebsiella pneumoniae Bloodstream Infections in a Neonatal Unit, South Africa

Rindidzani E. Magobo, Husna Ismail, Michelle Lowe, Wilhelmina Strasheim, Ruth Mogokotleng, Olga Perovic, Stanford Kwenda, Arshad Ismail, Manala Makua, Abram Bore, Rose Phayane, Harishia Naidoo, Tanya Dennis, Makhosazane Ngobese, Wim Wijnant, Nelesh P. Govender, for Baby GERMS-SA<sup>1</sup>

DISPATCHES

#### Emerging Corynebacterium diphtheriae Species Complex Infections, Réunion Island, France, 2015–2020

Thomas Garrigos,<sup>1</sup> Anais Grimal,<sup>1</sup> Edgar Badell, Nicolas Traversier, Sandrine Picot, Anne Lignereux, Mahery Ramiandrisoa, Céline Ben Cimon, Marie-Christine Jaffar-Bandjee, Houssein Gbaguidi-Haore, Julie Toubiana, Sylvain Brisse, Guillaume Miltgen,<sup>2</sup> Olivier Belmonte<sup>2</sup>

#### Dengue Outbreak Response during COVID-19 Pandemic, Key Largo, Florida, USA, 2020

Devin Rowe, Catherine McDermott, Ysla Veliz, Alison Kerr, Mark Whiteside, Mikki Coss, Chad Huff, Andrea Leal, Edgar Kopp, Alexis LaCrue, Lea A. Heberlein, Laura E. Adams, Gilberto A. Santiago, Jorge L. Munoz-Jordan, Gabriela Paz-Bailey, Andrea M. Morrison; Florida Department of Health Dengue Investigation Team<sup>1</sup>

https://wwwnc.cdc.gov/eid/



## Emerging Infectious Diseases Sounding the Alarm - 1992



**Emerging infectious diseases** are those whose incidence in humans has increased within the past two decades or whose incidence threatens to increase in the near future

May be due to:

- Spread of a new agent
- Recognition of a previously undetected agent
- Finding that an established disease has an infectious origin
- Reappearance of an agent after decline



## Emerging Infectious Diseases CDC - Addressing the Threats



http://www.cdc.gov/ncidod/diseases/eid/index.htm

## **Targets**

- Surveillance and Response
- Applied Research
- Infrastructure and Training
- Prevention and Control



## The Laboratory Response Network (LRN) A Model for Networking and Emergency Response



- National Labs CDC, USAMRIID, NMRC
- Reference Labs State & local PHLs, state agency labs
- Sentinel Labs Community clinical hospital labs

An **integrated network** of state & local public health, clinical, federal, military, & international laboratories to respond to bioterrorism, chemical terrorism and other public health emergencies.



## Emerging Infectious Diseases: it's not all about biothreat agents

## General preparedness to prevent and respond to



## "All Hazards"

(aka, surveillance and outbreak response of whatever comes next!)



## What has "All Hazards" looked like the past 20 years?

Mpox SARS-CoV-2 Elizabethkingia spp. Zika virus Dengue Chikungunya Ebola virus **EV-D68** SARS/MERS CoV VPDs (measles, mumps, pertussis) Foodborne outbreaks Antibiotic resistance Influenza A pdm2009H1, H5N1, H5Nx, H7N9, H3v, H1v





## The <u>Wisconsin Clinical Laboratory Network</u>: An "**All-hazards**" Network of Sentinel Labs









- 2022 epidemiologic curve ("epi curve") in the U.S.
- Outbreak not limited to the U.S.
- Previously a rare disease





## Which pathogen is this?

A) Staphylococcus aureus
B) Cowpox
C) Mpox
D) Influenza A/H1N1
E) Not a pathogen



## U.S. Mpox Case Trends Reported to CDC

Data as Reported to CDC as of 23 Aug 2023 2:00 PM EDT

#### Español Print

Trends of mpox cases reported to CDC during the 2022 outbreak by date\*

Make a selection from the filters to change the visualization information. Select the apply button to update the visualization information.





## U.S. Mpox Case Trends Reported to CDC

Data as Reported to CDC as of 23 Aug 2023 2:00 PM EDT

#### Español Print

Trends of mpox cases reported to CDC during the 2022 outbreak by date\*

Make a selection from the filters to change the visualization information. Select the apply button to update the visualization information.









## 2023 SA Grams

8/31/23 - 2022 Mpox Outbreak and return to normal reporting

On <u>October 4, 2022</u>, in accordance with the HHS Select Agent and Toxin Regulations, 42 C.F.R. § 73.5(a)(4) (iii), the Division of Select Agents and Toxins (DSAT) authorized less stringent reporting requirements for the identification of Mpox virus due to the 2022 Mpox Outbreak. This less stringent reporting allowed clinical and diagnostic laboratories and other entities that possess the HHS select agent to submit one consolidated report, using the APHIS/CDC Form 4, to report all identifications of Mpox virus for a 180-day period.

Today, on August 31, 2023, the Centers for Disease Control and Prevention (CDC) ended their public health response to the 2022 Mpox Outbreak, thereby marking the conclusion of the outbreak as determined by the CDC. Therefore, beginning on **October 30, 2023**, clinical and diagnostic laboratories and other entities are no longer allowed less stringent reporting for the identification of Mpox virus. Please note that an APHIS/CDC Form 4 must be submitted within seven calendar days after identification of Mpox virus. *See* 42 C.F.R. § 73.5(a)(4) and § 73.9(c)(2).

#### https://www.selectagents.gov/resources/sagrams/2023.htm



- Vectorborne disease
- Common globally, particularly in Southeast Asia and sub-Saharan Africa
  - One of the "Big three" infectious disease killers globally:
    - HIV, TB, and \_\_\_\_\_
- Cases in U.S. almost always travel associated
- 9 cases of locally-acquired (U.S.) in summer 2023



# Which pathogen is this?

A) Dengue
B) Measles
C) Zika
D) Malaria
E) Not a pathogen





HEALTH

Florida saw its seventh case of malaria this summer. One woman shares her ordeal

July 23, 2023 · 8:03 AM ET Heard on Weekend Edition Sunday

# This is an official CDC HEALTH UPDATE

Distributed via the CDC Health Alert Network August 28, 2023, 2:15 PM ET CDCHAN-00496

#### Important Updates on Locally Acquired Malaria Cases Identified in Florida, Texas, and Maryland

https://www.npr.org/2023/07/23/1189659889/florida-saw-its-seventh-case-of-malaria-this-summer-one-woman-shares-her-ordeal



- Florida identified seven cases of locally acquired *P. vivax*
- Texas identified one case of locally acquired *P. vivax*
- No reports of local transmission of malaria in Florida or Texas since mid-July 2023
- All Florida cases related genetically, and distinct from Texas case
- On August 18, 2023, a single case of locally acquired *Plasmodium falciparum* was reported in Maryland in the National Capital Region

- Ancient disease, known for millennia
- Caused by an acid-fast bacteria
- New recognition that it may be endemic in Florida



## https://phil.cdc.gov/Details.aspx?pid=21432



## Which pathogen is this?

A) Mycobacterium tuberculosis
B) Mycobacterium avium
C) Mycobacterium xenopi
D) Mycobacterium leprae
E) Not a pathogen



## Case Report of Leprosy in Central Florida, USA, 2022

#### Aashni Bhukhan, Charles Dunn, Rajiv Nathoo

Author affiliation: Kansas City University–Graduate Medical Education/Advanced Dermatology and Cosmetic Surgery Consortium, Orlando, Florida, USA

#### DOI: http://doi.org/10.3201/eid2908.220367

Florida, USA, has witnessed an increased incidence of leprosy cases lacking traditional risk factors. Those trends, in addition to decreasing diagnoses in foreignborn persons, contribute to rising evidence that leprosy has become endemic in the southeastern United States. Travel to Florida should be considered when conducting leprosy contact tracing in any state.

#### https://wwwnc.cdc.gov/eid/article/29/8/22-0367\_article



# Leprosy in Central Florida

- Since 2000, central Florida has accounted for:
  - 81% of cases reported in Florida
  - almost one fifth of nationally reported cases
- Several cases in central Florida demonstrate no clear evidence of zoonotic exposure or traditionally known risk factors
- Case report of lepromatous leprosy in central Florida in a man who never traveled outside of central Florida
- 34% of new case-patients in U.S. during 2015–2020 appeared to have locally acquired disease





- Occurs after a tick bite from the lone star tick
- Is becoming more common
  - Up to 450,000 people in U.S. may be affected
- Symptoms:
  - Mild: hives and itchy rash
  - More severe: including difficulty breathing and drops in blood pressure
- No treatment or cure



## https://www.mayoclinic.org/tick-species/sls-20147911?s=7



# Which pathogen causes this illness?

- A) Measles
- B) Dengue
- C) Rocky Mountain Spotted Fever
- D) Not a pathogen
- E) Heartland virus



# Tick-linked meat allergy may be far more common than previously known



- Alpha-gal syndrome (AGS): tickborne immune reaction
  - Also called alpha-gal allergy, red meat allergy, or tick bite meat allergy
- Alpha-gal: galactose-α-1,3-galactose is a sugar molecule found in most mammals



https://www.washingtonpost.com/health/2023/07/27/tick-red-meat-allergy/?utm\_campaign=wp\_post\_most&utm\_medium=email&utm\_source=news/https://en.wikipedia.org/wiki/Galactose-alpha-1,3-galactose

- Alpha-gal found in red meat (pork, beef, rabbit, lamb, venison, etc.); **not** found in fish, reptiles, birds, or people
- Tick bites a person and injects the alpha-gal sugar molecule found in its saliva
- In some people, that sugar causes an allergic reaction, which is further triggered by eating red meat
- Association with Lone Star tick bites made in 2009
- AGS associated with the bite of a Lone Star tick in the United States, but other kinds of ticks have not been ruled out
- Other tick species have been connected with the development of AGS in other countries





## Identifying New Pathogens by Metagenomic Sequencing









Identifying New Pathogens by Metagenomic Sequencing



Published Date: 2019-12-30 23:59:00 Subject: PRO/AH/EDR> Undiagnosed pneumonia - China (HU): RFI

Patients with unknown cause of pneumonia in Wuhan have been isolated from multiple hospitals





Published Date: 2020-01-05 18:15:37 Subject: PRO/AH/EDR> Undiagnosed pneumonia - China (HU) (03): updates, SARS, MERS ruled out, WHO, RFI



Published Date: 2020-01-08 23:19:25 Subject: PRO/AH/EDR> Undiagnosed pneumonia - China (HU) (07): official confirmation of novel coronavirus Archive Number: 20200108.6878869



# How did they know it was a new coronavirus?



Published Date: 2020-01-11 12:25:54

Subject: PRO/AH/EDR> Undiagnosed pneumonia - China (HU) (10): genome available, Hong Kong surveill.

• Next-generation sequencing



# Metagenomics



Bacterial genomes, Human DNA, Human RNA, Virus DNA/RNA reads

# Metagenomics

- Millions of reads per specimen
- Each read, use huge databases to determine:
  - Is it human?
    - If Y, discard
  - Is it known bacterial/viral/plant/other?
    - If Y, discard
  - What else is left?
    - Reads that don't match any known sequences
    - Reads that match sequences only ok
      - Not exact matches, but close to other coronaviruses
    - From these reads, can we reconstruct the genome?



# **Sequence Assembly**



• Overlapping data to reconstruct the entire viral genome (>29,000bp)



Figure 4. Phylogenetic Analysis of 2019-nCoV and Other Betacoronavirus Genomes in the Orthocoronavirinae Subfamily.



# Why is the genome so powerful?

- Compare to other CoV to guess where it originated (bats?)
- Compare multiple SARS-CoV-2 sequences (variants!)
- The first step to develop diagnostics
  - Too expensive and slow to do next-generation sequencing on everything
  - Compare to other CoV to look for unique sections in SARS-CoV-2
  - Develop real-time PCR for high-throughput diagnosis



