



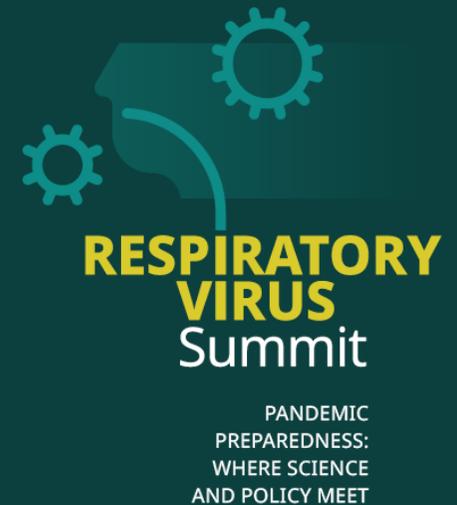
RESPIRATORY VIRUS Summit

organised by **ESWI**

PANDEMIC
PREPAREDNESS:
WHERE SCIENCE
AND POLICY MEET

Future preparedness for newly emerging infectious diseases

Prof. Zhengli Shi, *Wuhan Institute of virology, China*



Respiratory virus summit

Future preparedness for newly emerging infectious diseases (EIDs)

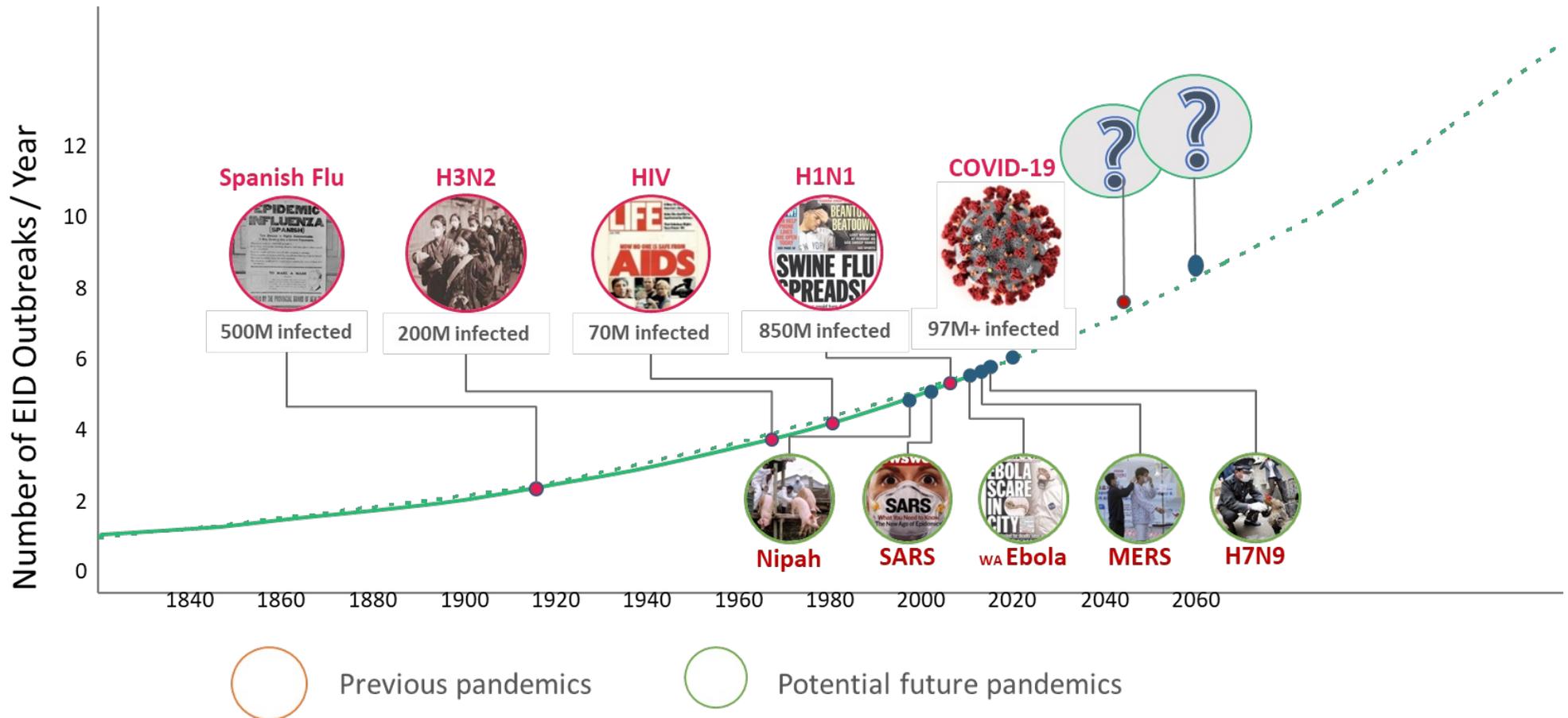
Zhengli Shi

Wuhan Institute of Virology, Chinese Academy of Sciences

zlshi@wh.iov.cn

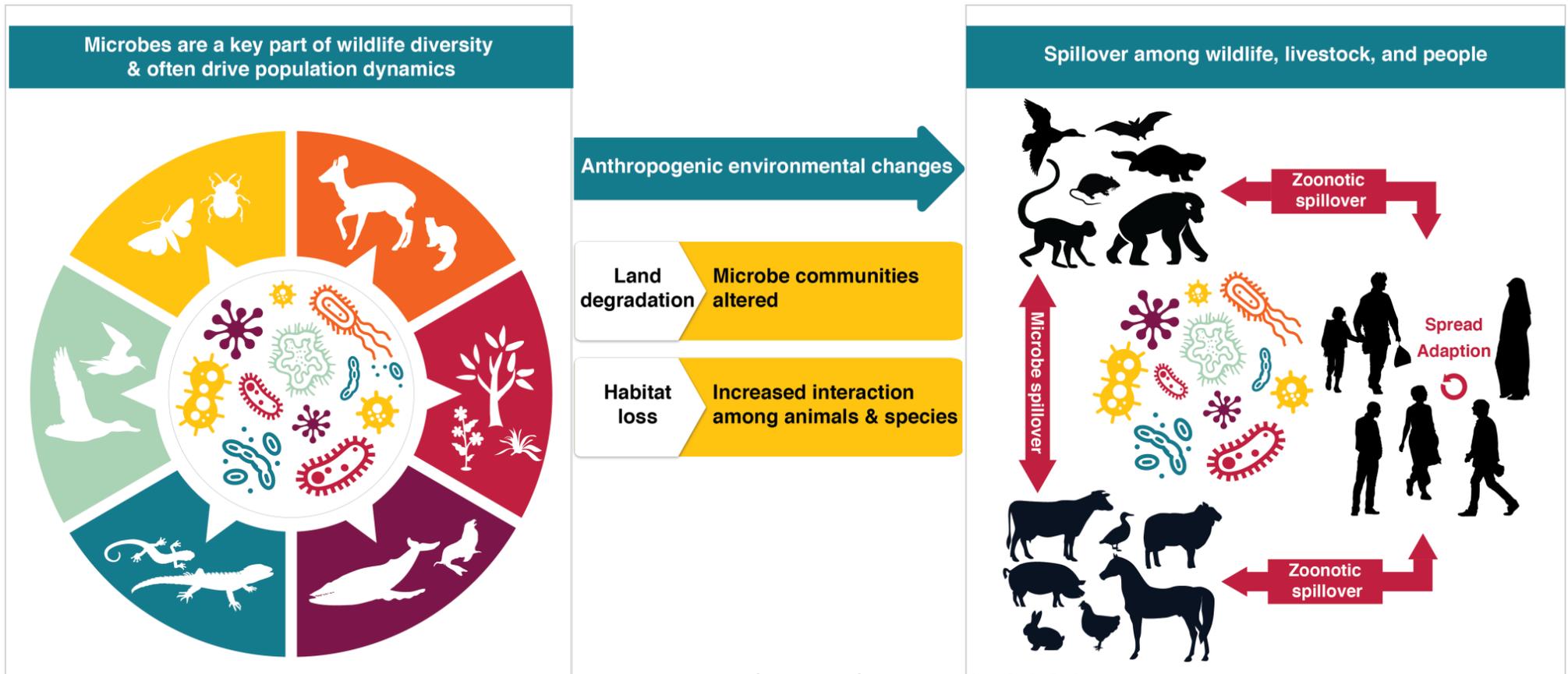
June 21, 2022

Majority of EIDs are zoonotic



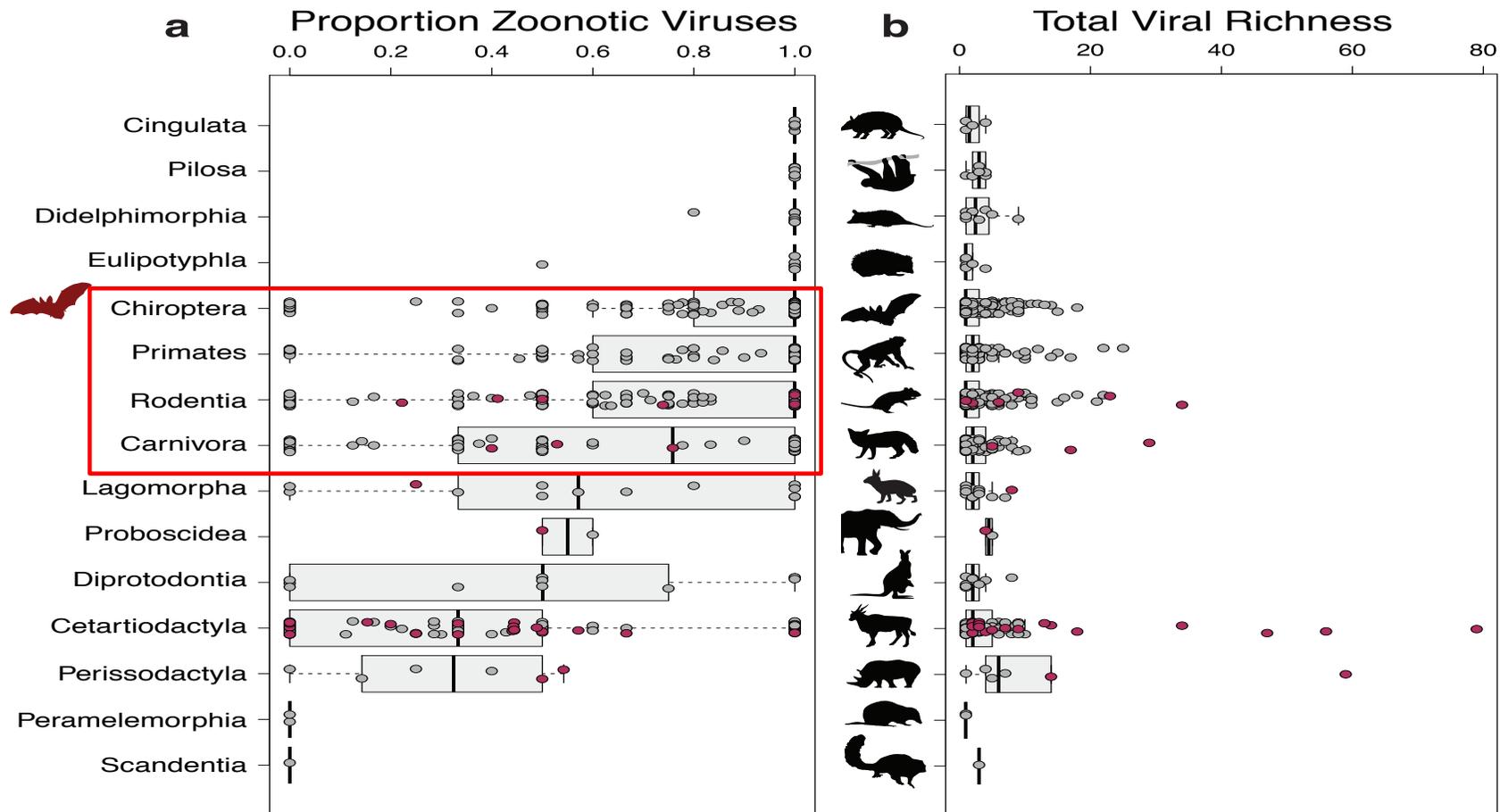
Allen et al., Nature Communications, 2017; Pike et al., PNAS, 2014

Key factors involved in EIDs



Daszak *et al.* IPBES. 2020

Natural reservoirs of viruses



Olival *et al.*, *Nature*, 2017

Bat viruses discovered by our team

Astrovirus

Adenovirus: **6 isolates**

Adeno-associated virus

Circovirus

Coronavirus: **3 isolates**

Filovirus

Hantavirus

Hepadnavirus

Reovirus: **8 isolates**

Paramyxovirus

Li et al., J. Virol, 2010;

Li et al., J. Gen Virol, 2010;

Ge et al., J. Gen Virol, 2011;

Ge et al., J. Virol, 2012;

Yang et al., J Gen Virol, 2015;

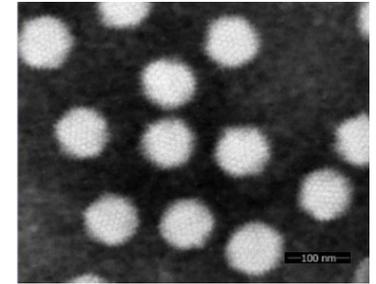
Tan et al., J Gen Virol, 2016; 2017;

Yang et al., Emerg Infect Dis, 2017; Luo et al., J Virol, 2018;

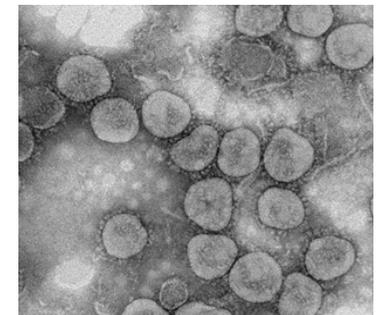
Yang et al., Nature Microbiol, 2019;

Zhou et al., Nature, 2020;

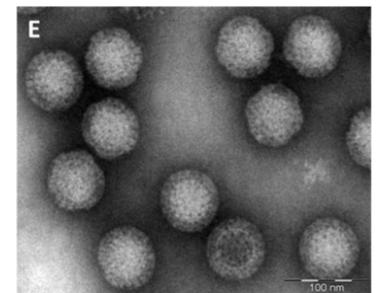
Guo et al., Emerg Microbe Infect, 2021



Adenovirus

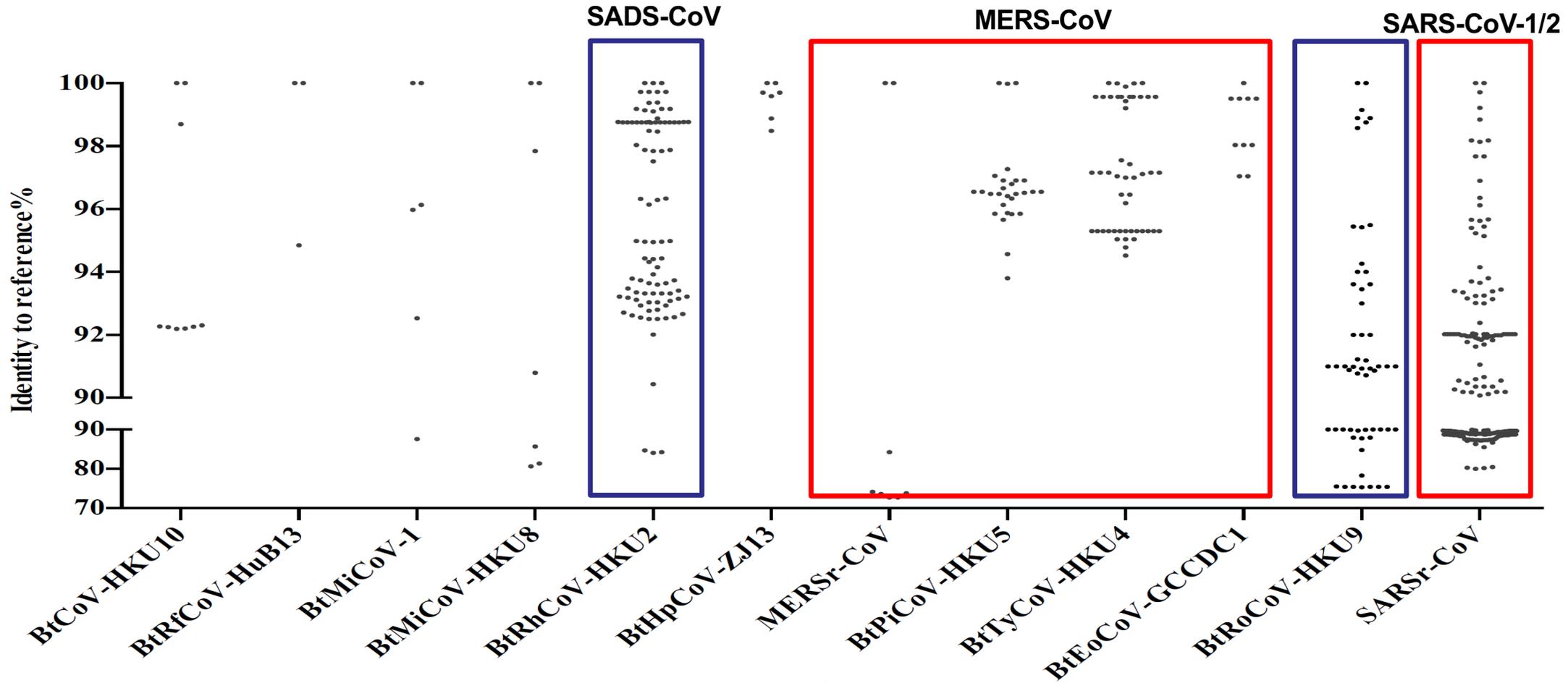


Coronavirus



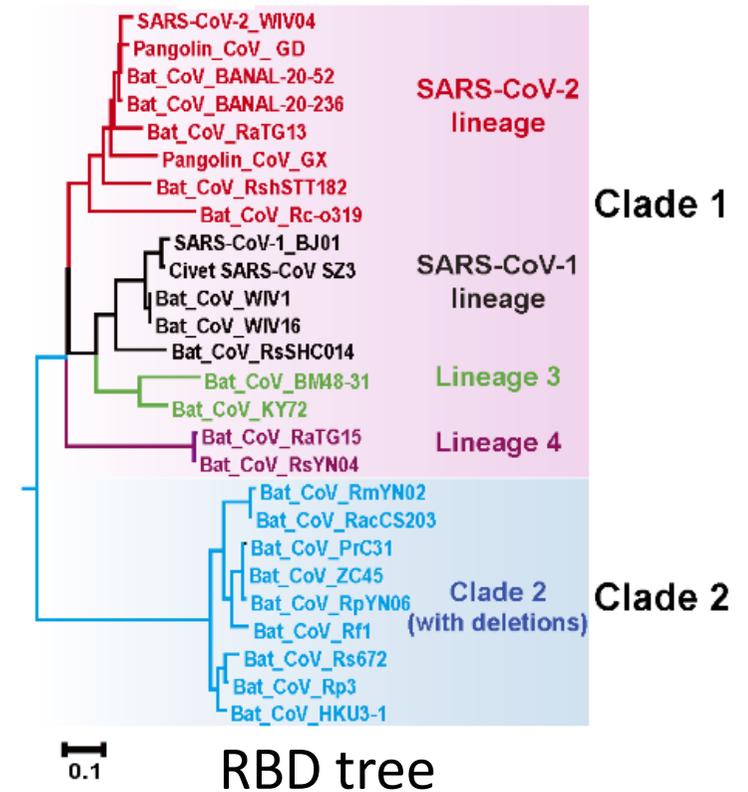
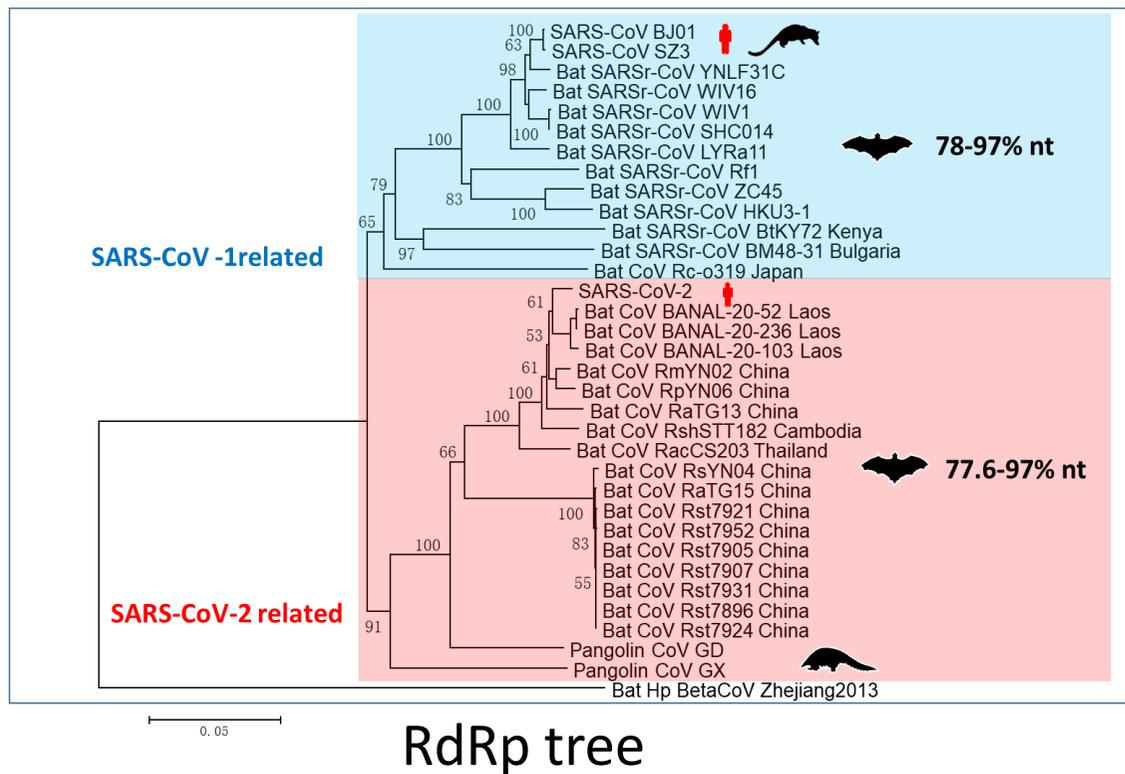
Reovirus

Genetic diversity of bat coronavirus in China



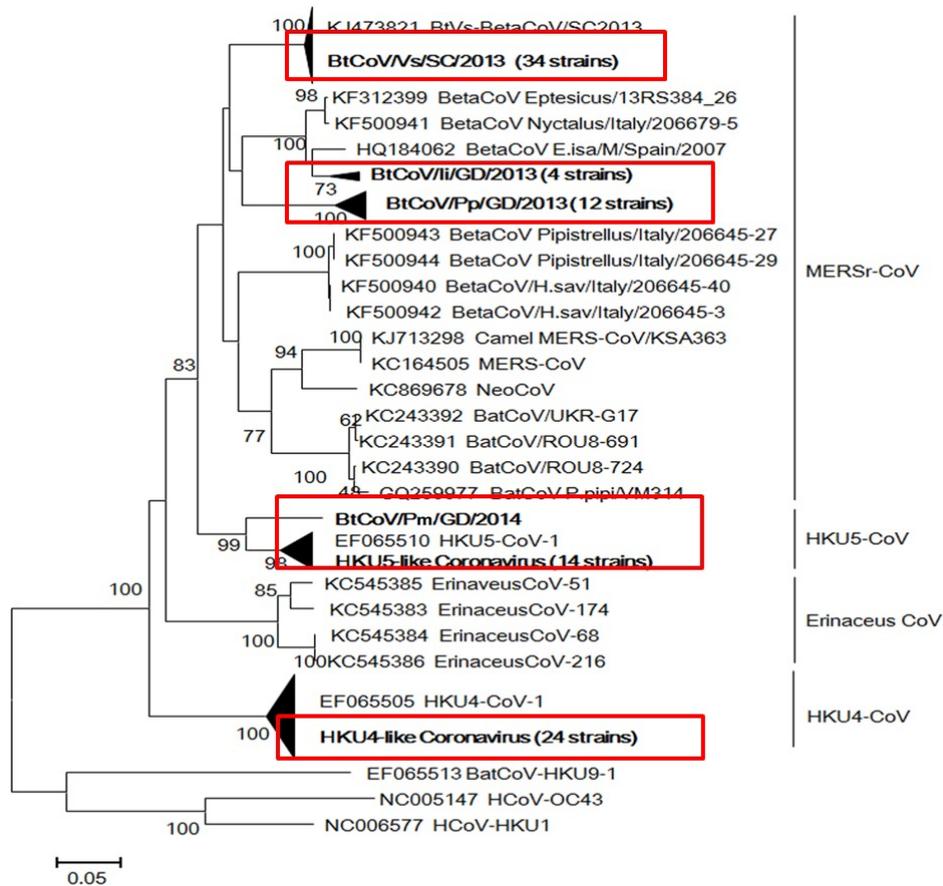
Fan *et al.*, *Viruses*, 2019; Cui *et al.*, *Nat Rev Microbiol*, 2019

SARS-related coronavirus in Rhinolophus bats



Hu et al., *Front Microbiol*, 2022 (in press)

MERS-CoV-cluster viruses in bats and utilizes human DPP4 as receptor



Bat Origins of MERS-CoV Supported by Bat Coronavirus HKU4 Usage of Human Receptor CD26

Qihui Wang,¹ Jianxun Qi,¹ Yuan Yuan,^{1,2} Yifang Xuan,³ Pengcheng Han,⁴ Yuhua Wan,^{1,5} Wei Ji,⁶ Yan Li,¹ Ying Wu,¹ Jianwei Wang,⁷ Aikichi Iwamoto,^{8,9} Patrick C. Y. Woo,^{10,11} Kwok-Yung Yuen,^{10,11,12} Jinghua Yan,¹ Guangwen Lu,¹ and George F. Gao^{1,2,3,6,12,13,*}

Wang et al., Cell Host Microbe, 2014

Receptor Usage of a Novel Bat Lineage C Betacoronavirus Reveals Evolution of Middle East Respiratory Syndrome-Related Coronavirus Spike Proteins for Human Dipeptidyl Peptidase 4 Binding

Susanna K. P. Lau,^{1,2,3,4} Libiao Zhang,^{5,6} Hayes K. H. Luk,^{2,4} Lifeng Xiong,^{2,4} Xingwen Peng,⁵ Kenneth S. M. Li,² Xiangyang He,⁵ Pyreare Su-Hui Zhao,² Rachel Y. Y. Fan,² Antonio C. P. Wong,² Syed Shakeel Ahmed,² Jian-Piao Cai,² Jasper F. W. Chan,^{1,2,3,4} Yinyan Sun,⁶ Dongyan Jin,⁷ Honglin Chen,^{1,2,3,4} Terrence C. K. Lau,⁸ Raven K. H. Kok,^{1,2,3,4} Wenhui Li,⁶ Kwok-Yung Yuen,^{1,2,3,4} and Patrick C. Y. Woo^{1,2,3,4}

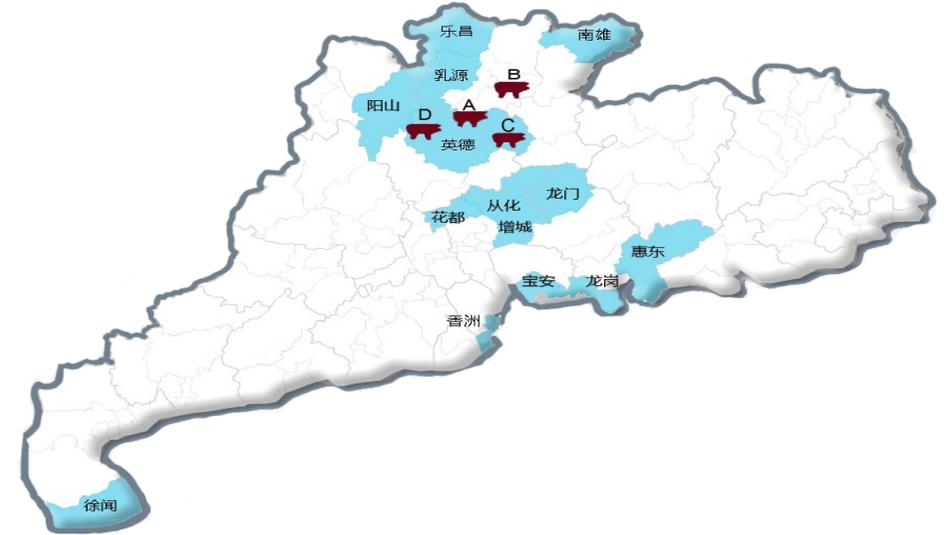
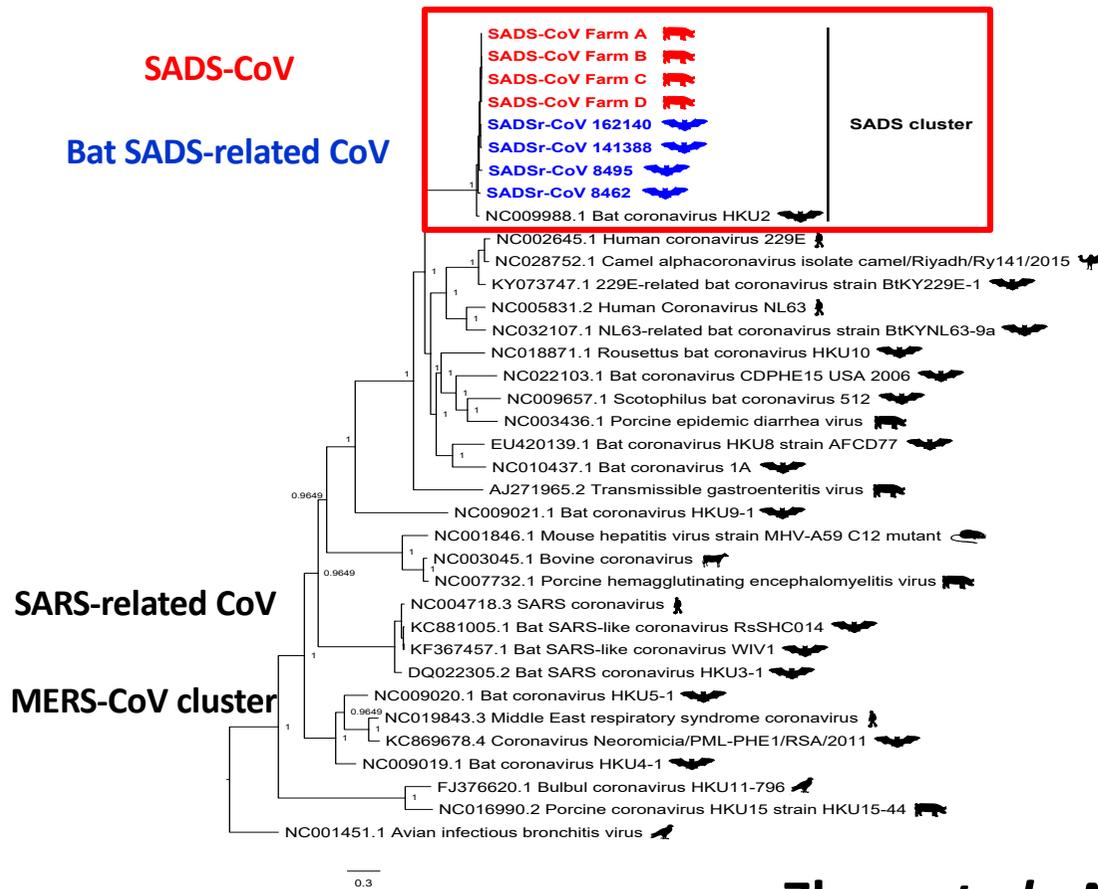
Lau et al., J Infect Dis, 2018, Nat Commun 2021

Discovery of Novel Bat Coronaviruses in South China That Use the Same Receptor as Middle East Respiratory Syndrome Coronavirus

Chu-Ming Luo,^{a,b,c} Ning Wang,^{a,b} Xing-Lou Yang,^a Hai-Zhou Liu,^a Wei Zhang,^a Bei Li,^a Ben Hu,^a Cheng Peng,^a Qi-Bin Geng,^c Guang-Jian Zhu,^d Fang Li,^c Zheng-Li Shi^a

Luo et al., JVI, 2018

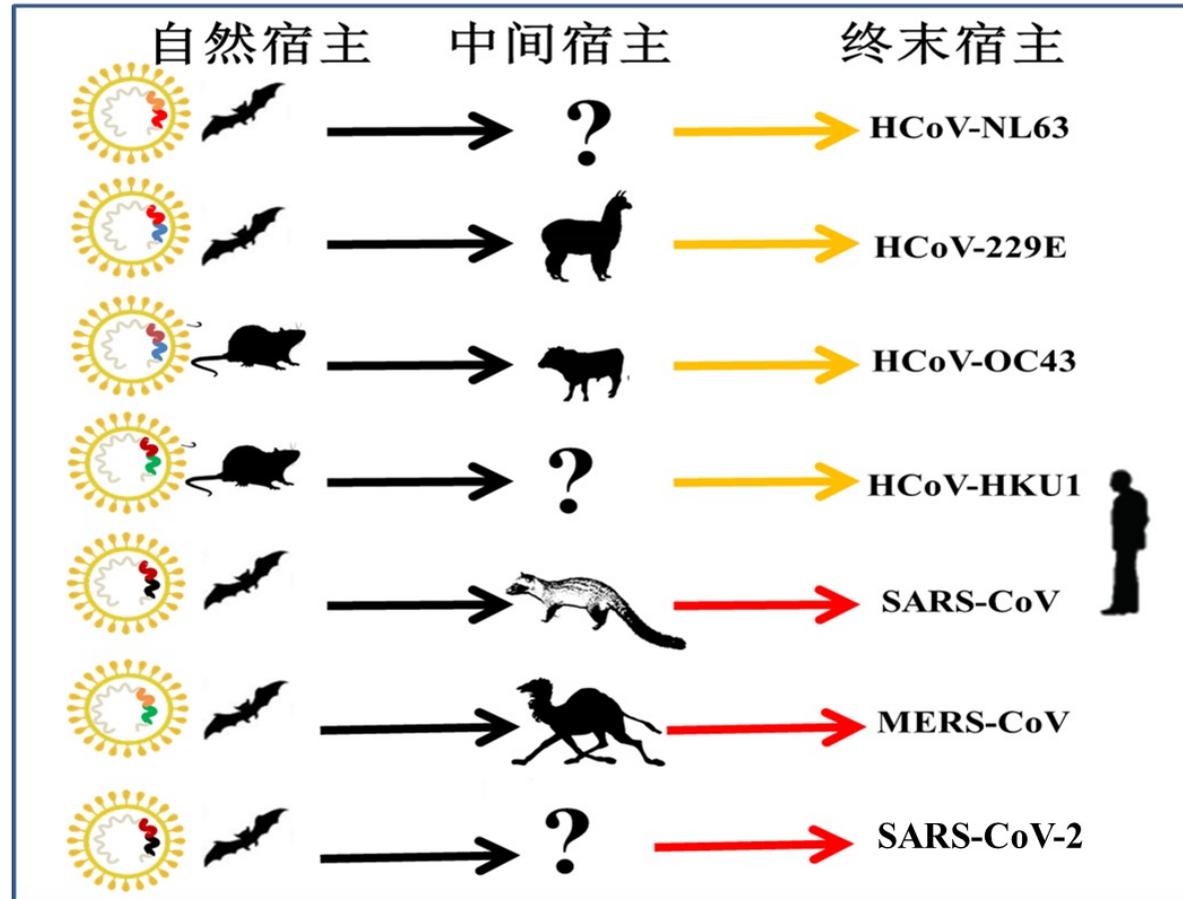
Swine acute diarrhea syndrome coronavirus (SADS-CoV), originates in Rhinolophus bats



- 9.8% rhinolophus bats carry SADS-related CoV
- Genome: 96-98% nt identity
- Spike protein: 87-98% aa identity
- SADS-CoV has a wide host range

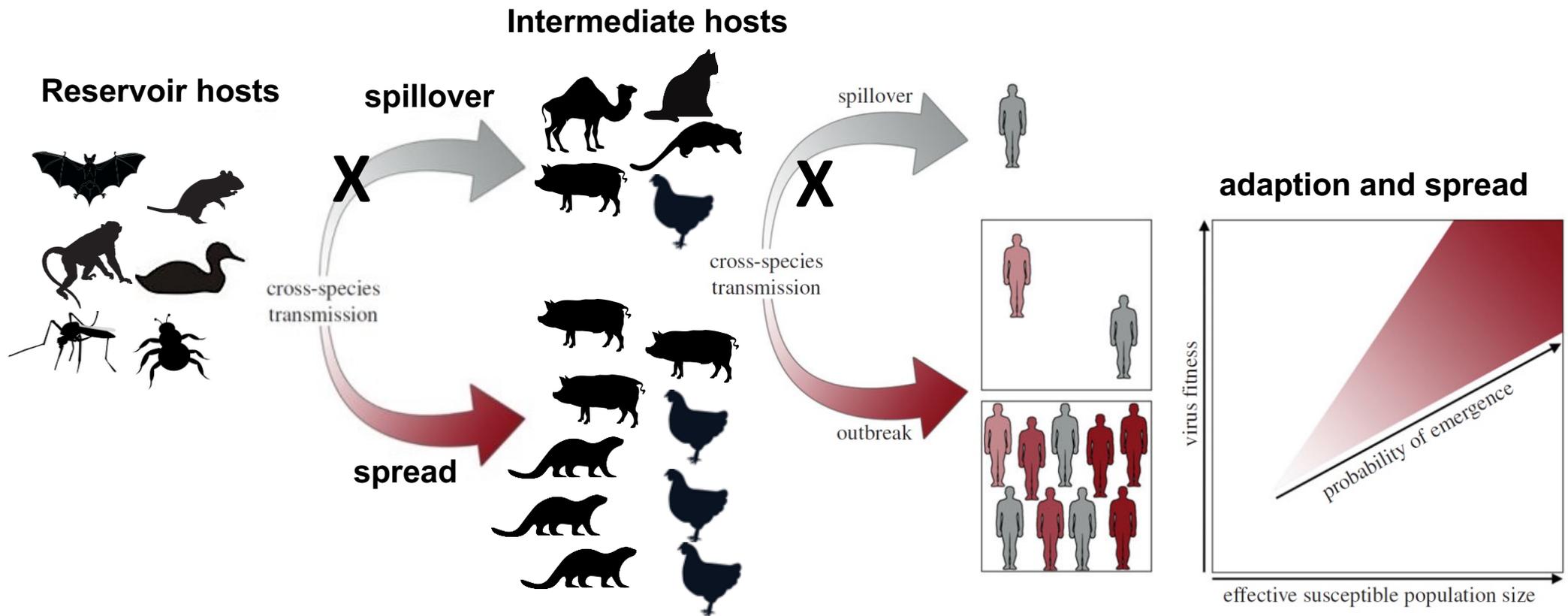
Zhou *et al.*, *Nature*, 2018

All human coronaviruses has an animal origin



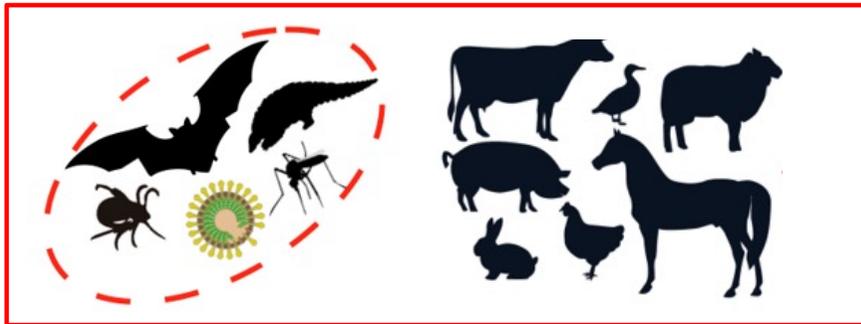
Cui et al., Nat Rev Microbiol, 2019

How to predict and prevent the newly emerging infectious diseases



Adapted from Geohegan and Holmes, *Open Biology*, 2017, 7(10):170189

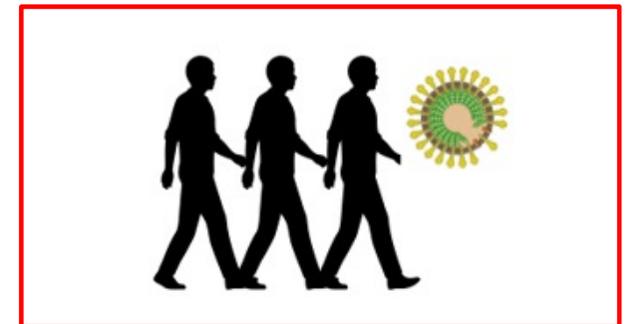
Pre-emptive strategies against future EIDs



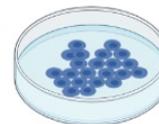
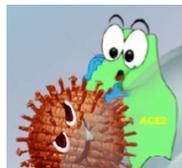
Surveillance & Precaution



Pathogen biology



Countermeasure



Pathogen discovery

Genomics characterization

Mutation and evolution analysis

Epidemiology testing

Prediction modeling

Structure and function

Entry & replication mechanism

Infection models

pathogenesis

Cross-species risk assessment



Development & Reserve of

Diagnostic methods

Antivirals & Antibodies

Vaccines

Challenge

Pathogen investigation

Data sharing

Collaboration

Transparency

One-health implement

Thanks