### **Reverse Zoonosis and Covid-19**

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# Pathogens

- **Bacteria:** TB, Shigella, Salmonella, Heliobacter, MRSA, Lyme disease
- Viruses: Influenza, SARS, Covid19, Rotavirus, Measles Hepatitis E, Ebola, Pox, Rabies
- Parasites: Isopera, Giardia, Strongyloides
- Fungi: Candida, Trichophyton, Mircosporum

#### Distribution of reverse zoonotic events



#### Tuberculosis in human, 2014

Estimated TB mortality rates excluding TB deaths among HIV–positive people, 2014



#### Tuberculosis in human, 2014

Estimated TB mortality rates excluding TB deaths among HIV–positive people, 2014



Journal of Zoo and Wildlife Medicine 34(4): 364-370, 2003 Copyright 2003 by American Association of Zoo Veterinarians



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#### Reverse Zoonosis of N1H1 influenza



Sooksawasdi Na Ayudhya, 2021

#### Reverse Zoonosis of N1H1 influenza



Sooksawasdi Na Ayudhya, 2021

#### **Reverse Zoonosis of Covid19**



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#### **Reverse Zoonosis of Covid19**



Denver Zoo reports world's first coronavirus cases in hyenas, ksawasdi Na Ayudhya, 2021

By THOMAS PEIPERT November 6, 2021

#### **Reverse Zoonosis of Covid19**



Multiple spillovers and onward transmission of SARS-Cov-2 in free-living and captive White-tailed deer (Odocoileus virginianus)

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#### **Recent Pandemics**

Pandemic (years and common name)	Reference	Causative agent	Area Of emergence	Estimated reproductive number	Secondary attack rates (%)	Estimated case-fatality rate	Age groups most affected
1918–1919 (Spanish flu)	[6]	Influenza A (H1N1)	Unclear	1.7–2.8	-	NA	Adult, pregnant
1957–1958 (Asian flu)	[8]	Influenza A (H2N2)	Southern Chine	1.8	18.5–26.8	NA	Children, elderly
1968–1969 (Hong Kong flu)	[11]	Influenza A (H3N2)	Southern Chine	1.06-2.06	15.0	NA	Elderly
2009 (swine flu)	[18]	Influenza A (H1N1)	Mexico	1.4–1.6	17,5	NA	Adolescent, young adults
2019–(COVID-19)		A Novel Coronavirus (SARS-CoV-2)	Wuhan, Chine	5.7	< 2	2.3	Elderly

Akin abd Gökhan, 2020

#### Cases of Covid-19 in animals



OIE situation report 30 September 2021

# Animal species affected

Russia

Australi



Canada

United States

Cat

- Dog
- Gorilla
- Lion
- Mink
- Otter
- Pet Ferret
- 🔺 Tiger
- White tailed deer

## No of outbreaks in animals

Species Region	Cats	Dogs	Mink	Otter	Pet ferrets	Lions	Tigers	Pumas	Snow leopards	Gorillas	White- tailed deer	Amur leopard
Africa						(1)		(1)				
Americas	67	69	20	2	1	3**	10+	2	2+	2	1	+
Asia	11	16					1					
Europe	24	7	340		1	2*	1*					
TOTAL	102	92	360	2	2	5	12	3	2	2	1	+

OIE, Sept 2021

### Covid-19 South Africa



Koeppel et al, in prep

#### **Covid-19 South Africa**



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	ORF1a							OR	F1b		S													ORF3a	м	ORF6	ORF7a			7a		RF8	ORF9b	N					
	82	83	84	85	1640	3055	3209	3718	3750	314	662	765	1000	19	142	156	157	158	222	250	338	452	478	614	681	950	26	82	60	5	82	95	120	119	120	60	63	203	377
ZRU125/21					P/L		A/V	V/A	Т/І	P/L	G/S	G/C	P/L	T/R	G/D	del	del	R/G	A/V	T/S		L/R	т/к	D/G	P/R	D/N	S/L	і/Т			V/A		Т/І	del	del	T/A	D/G	R/M	D/Y
ZRU127/21					•		•	•	•	•	•	•	•	•	•	•	•	•	•	•		•	•	•	•	•	•	•			•		•	•	•	•	•	•	•
ZRU128/21					•		•	•	•	•	•	•	•	•	•	•	•	•	•	•		•	•	•	•	•	•	•			•		•	•	•	•	•	•	•
ZRUCWL005					•		•	•	•	•	•	•	•	•	•	•	•	•	•	•		•	•	•	•	•	•	•	I/V		•		•	•	•	•	•	•	•
ZRUCWL012	del	del	del	M/V	•	I/T	•	•		•	•		•	•	•	•	•	•	•		F/L			•		•		•		L/F	•	E/A		•	•	•	•	Ì	

Black dots: identical change; Grey blocks: no data

#### Koeppel et al, in prep

# Causes of spillover

- Sufficient contact between human and animal species
- Compatibility between pathogen and new host
- Transmission in new host = pathogen persist or die out
- Reservoir species

86.640

Imperial College London News by Dr Sabine van Elsland

#### Collaborators: Marietjie Venter Adriano Mendes Amy Strydom Lia Rotherham Misheck Mulumba







### Questions ?





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