Institute of zoology

2014 International Workshop on Feral Swine Disease and Risk Management

By *Hongxuan He*

Feral swine diseases prevention and control in China

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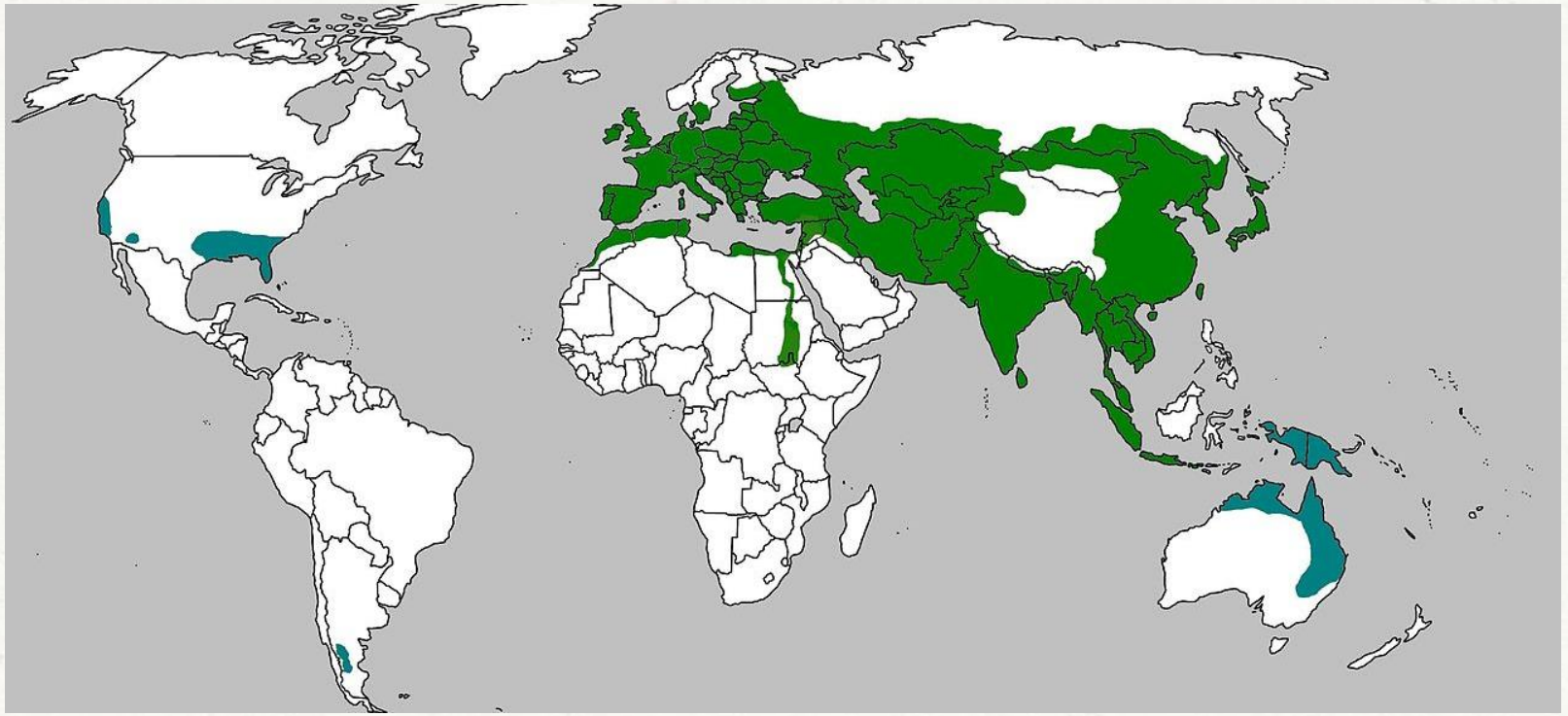
Feral swine in China

Scientific Classification

Scientific name: *Sus scrofa* Linnaeus
Common name: Wild boar, wild hog, feral swine, feral pig, feral hog, Old World swine, razorback, Eurasian wild boar, Russian wild boar
Feral swine is one of the most widespread group of mammals, which can be found on every continent expect Antarctica.

World distribution of feral swine



Reconstructed range of feral swine (green) and introduced populations (blue).
Not shown are smaller introduced populations in the Caribbean, New Zealand, sub-Saharan Africa and elsewhere.

Species of feral swine

Now ,there are 4 genera and 16 species recorded in the world today.

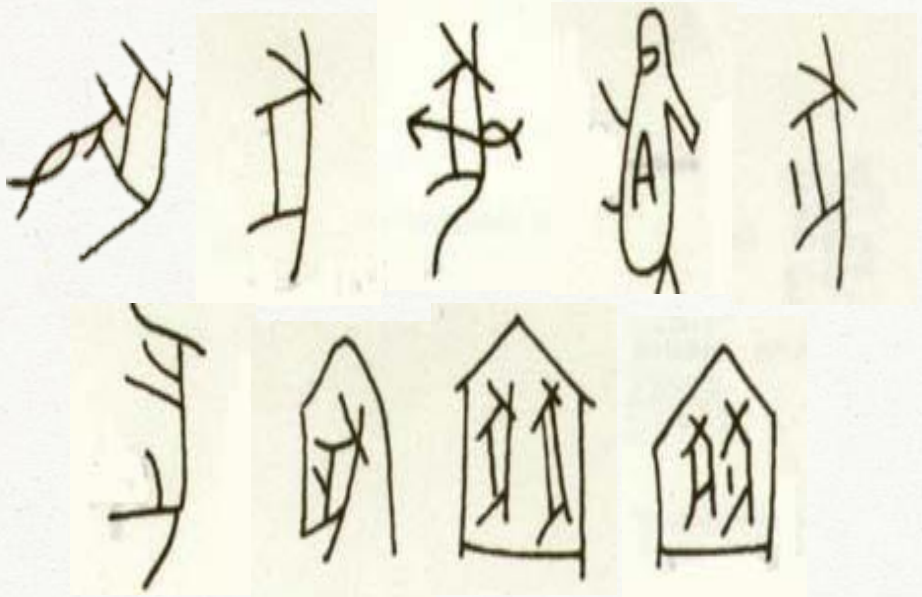
Western genus	Indian genus	Eastern genus	Indonesian genus
Sus scrofa scrofa *Sus scrofa meridionalis* *Sus scrofa algira* *Sus scrofa Attila* *Sus scrofa nigripes* *Sus scrofa libycus* *Sus scrofa majori*	*Sus scrofa davidi* *Sus scrofa cristatus*	*Sus scrofa sibiricus* *Sus scrofa ussuricus* *Sus scrofa leucomystax* *Sus scrofa riukiuanus* *Sus scrofa taivanus* *Sus scrofa moupinensis*	*Sus scrofa vittatus*

Feral swine in China

Feral swine has a long history in China. About 10,000 years ago, Chinese began to domesticate feral swine.

Feral swine in China

Domesticated history in China

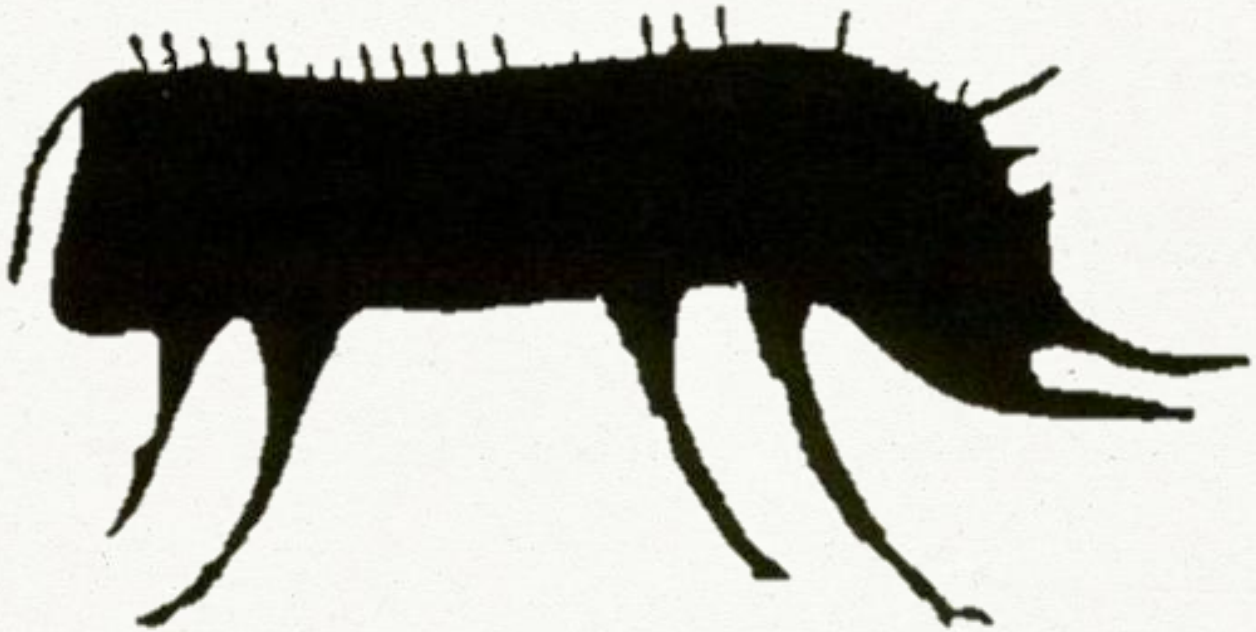


oracle bone inscriptions **of “猪” in Shang Dynasty**

Different font of “猪”

Feral swine in China

Domesticated history in China



The carving of pig in Han Dynasty

Feral swine in China

Domesticated history in China

In ancient time, people domesticated pig in “Zhu juan”.

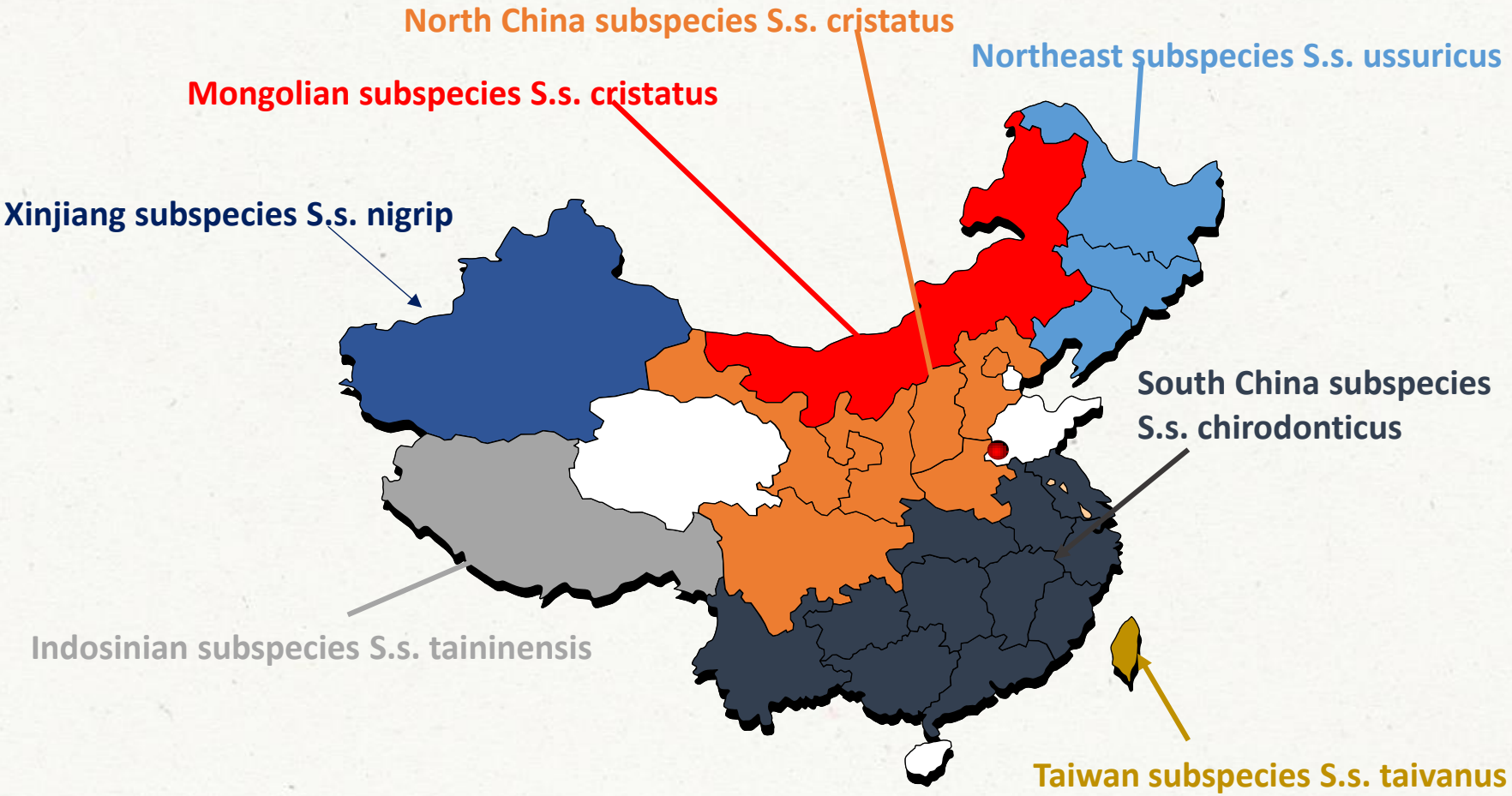
Feral swine in China

Species of feral swine

- Northeast subspecies S.s. ussuricus
- North China subspecies S.s. cristatus
- South China subspecies S.s. chirodonticus
- Xinjiang subspecies S.s. nigrip
- Mongolian subspecies S.s. cristatus
- Taiwan subspecies S.s. taivanus
- Indosinian subspecies S.s. taininensis

Now ,there are 1 kind of 7 subspecies in China.

Feral swine in China



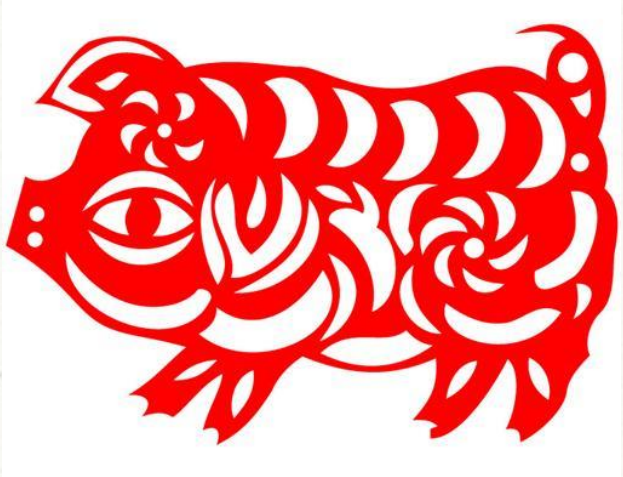
The distribution of feral swine in China

Distribution of feral swine in China

Distribution	Area	Density	Number
Beijing	1142	0.04	50
Shanxi	—	0.0119～0.2023	8000
Hebei	—	0.0007088	3000
Neimenggu	210 000	0.2574	54 000
Liaoning	—	0.0052～0.0125	600
Jilin	85 900	0.2846	25 000
Heilongjiang	290 911	0.0909	26 000
Jiangsu	—	—	600
Zhejinag	60 889	0.15～0.88	29 000
Fujian	—	—	100 000
Jiangxi	81 850	2.292	360 000
Henan	—	0.4302～0.5938	46 000
Hubei	87 554	1.5982	140 000
Hunan	—	0.09896	13 000
Guangdong	—	0.51～1.14	50 000
Guangxi	232 600	0.058～0.134	12 000
Hainan	—	—	500
Chongqing	24 308	—	350
Sichuan	—	0.1249～0.2757	8800
Guizhou	176 167	0.2108	36 000
Yunnan	13 730	—	32 000
Xizang	—	0.0442	4900
Shanxi	45 637	0.8948	40 000
Gansu	—	0.00535～0.22752	9000
Ningxia	1600	0.386	300
Total			1 000 000

Feral swine in China

In ancient time, pigs represent auspiciousness , festival and good fortune. At the same time, feral swine represents brave and strong. About 10,000 years ago, Chinese began to domesticate feral swine for meat products.



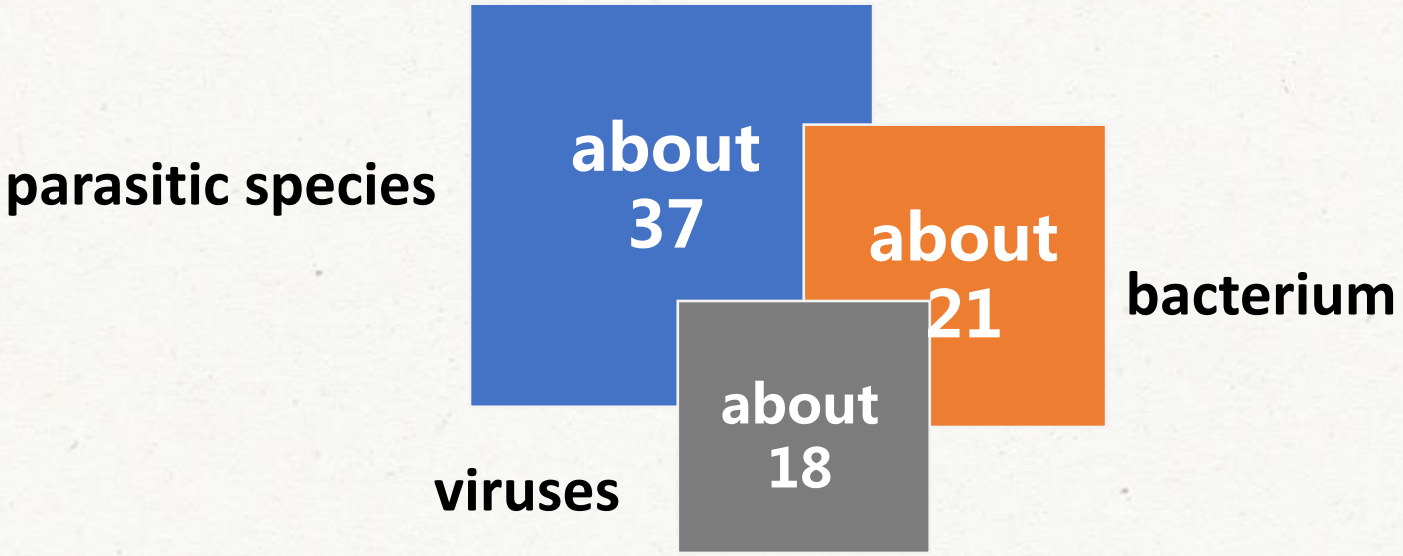
Feral swine in China

Feral swine has been listed in the state forestry administration released on August 1, 2000, “the list of terrestrial wildlife which is beneficial or has important economic and scientific research value ".It belongs to the animals under state protection (category ii).

Now, feral Swine in China is expanding their range, both on their own and with human assistance. We should take measures to control their quantity.

Diseases of feral swine

Diseases of feral swine



As it is reported, domestic swine host about 21 kinds of bacterium, 18 kinds of viruses and 37 kinds of different parasitic species. Some of diseases can transmit in feral swine.

Diseases of feral swine

Viral Diseases

- Swine influenza(SI)
- Classical swine fever
- Food and mouth disease(FMD)
- Vesicular stomatitis
- Porcine parvovirus disease
- ……

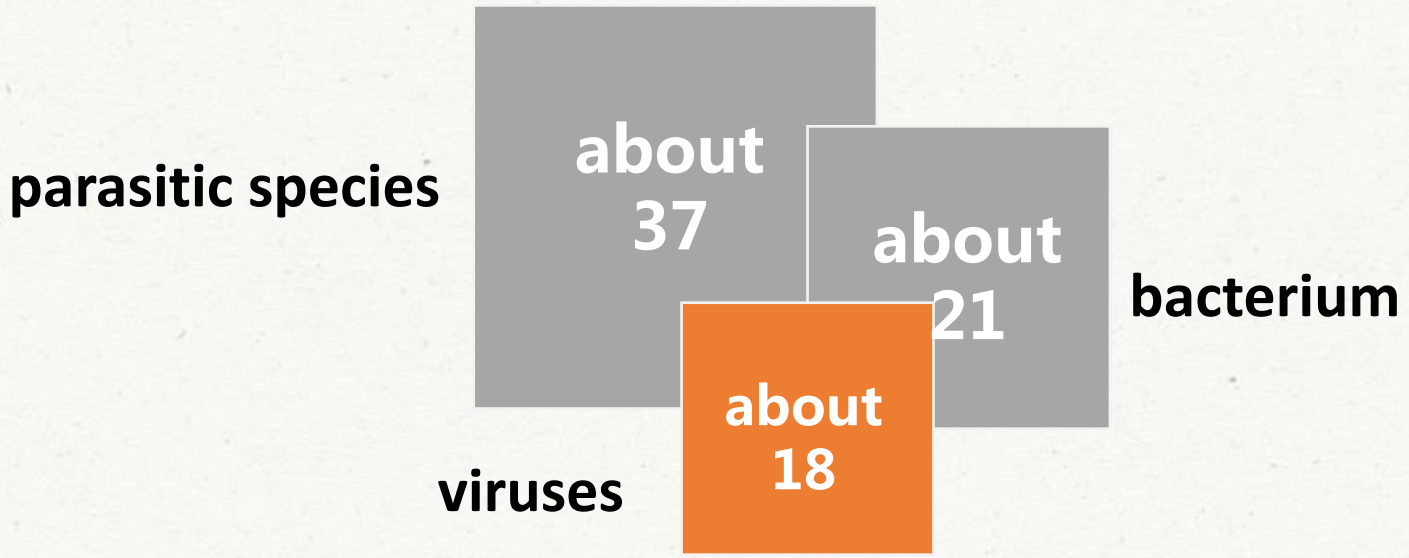
Bacterial Diseases

- Brucellosis
- Anthrax of swine
- Tuberculosis
- Swine erysipelas
- Swine pasteurellosis
- ……

Parasitic species

- Trichinosis
- Cysticercosis cellulosae
- Ascariosis of swine
- Toxoplasmosis
- Sarcoptidosis
- ……

Diseases of feral swine

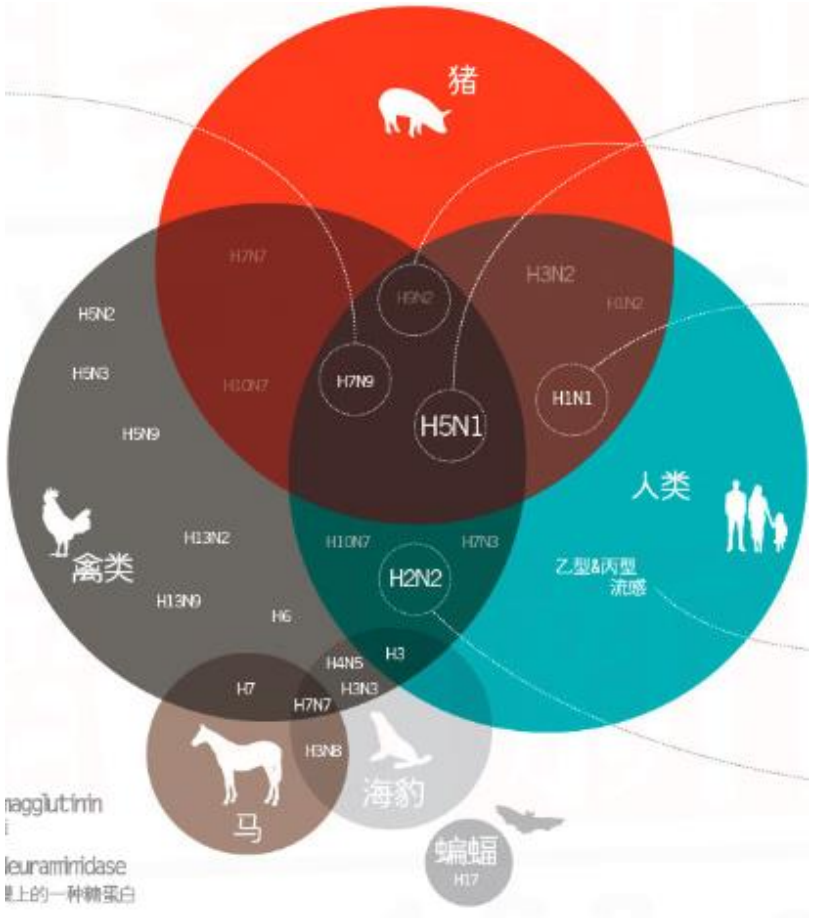


Diseases of feral swine

Influenza

Influenza is caused by RNA viruses of the family *Orthomyxoviridae*, the influenza viruses.

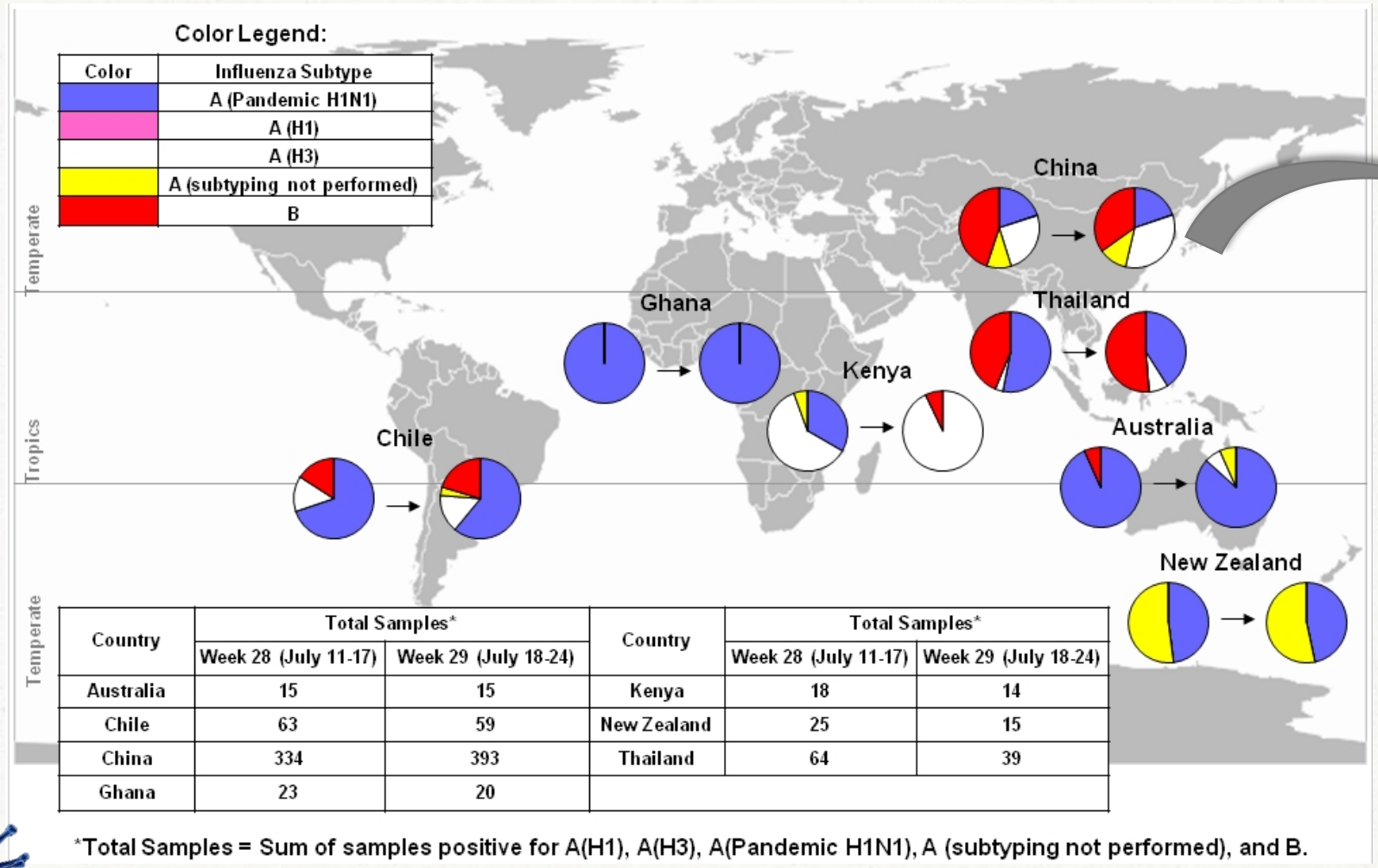
Orthomyxovirus	
Virus classification	
Group	Group V ((-)ssRNA)
Order	Unassigned
Family	Orthomyxoviridae



Feral swine serves as a major reservoirs of H1N1 H3N2,H5N1 and H7N9 influenza viruses which are endemic in feral swine populations worldwide.

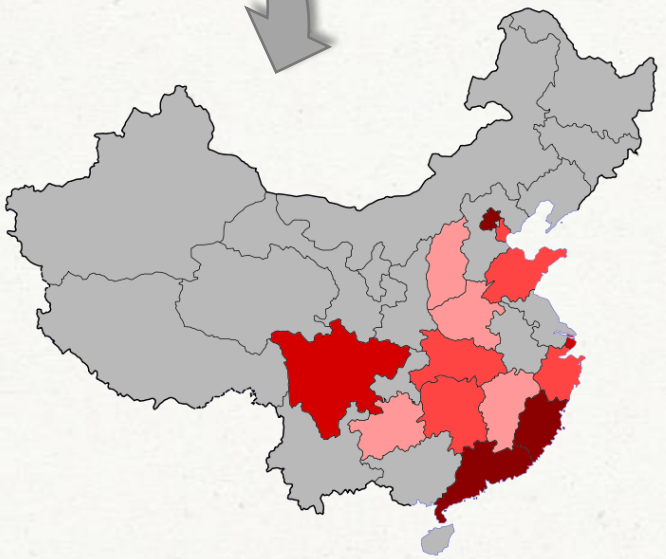
Diseases of feral swine

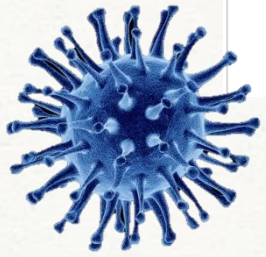
Influenza



Country	Total Samples*		Country	Total Samples*	
	Week 28 (July 11-17)	Week 29 (July 18-24)		Week 28 (July 11-17)	Week 29 (July 18-24)
Australia	15	15	Kenya	18	14
Chile	63	59	New Zealand	25	15
China	334	393	Thailand	64	39
Ghana	23	20			

*Total Samples = Sum of samples positive for A(H1), A(H3), A(Pandemic H1N1), A (subtyping not performed), and B.

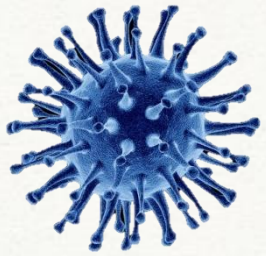




Diseases of feral swine

Influenza

Feral swine can be infected by both avian viruses and human viruses, and as a intermediate host in which viruses can reassort . Feral swine also serves as adaptation host in which avian viruses can mutate to become more infectious for humans.

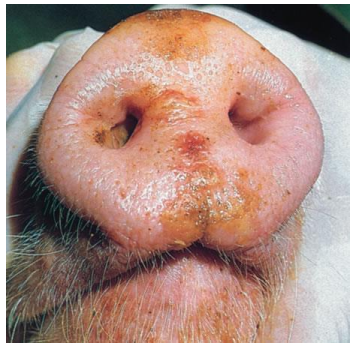


Diseases of feral swine

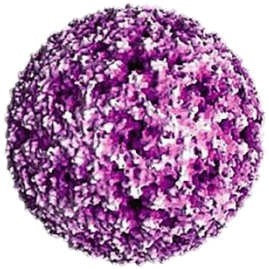
Foot and mouth disease

Foot and mouth disease is caused by FMD virus (FMDV) an RNA virus of the genus *Aphthovirus* of the *Picornaviridae* family.

Foot-and-mouth disease virus	
Virus classification	
Group:	Group IV ((+)ssRNA)
Order:	Picornavirales
Family:	Picornaviridae
Genus:	Aphthovirus
Species:	Foot-and-mouth disease virus

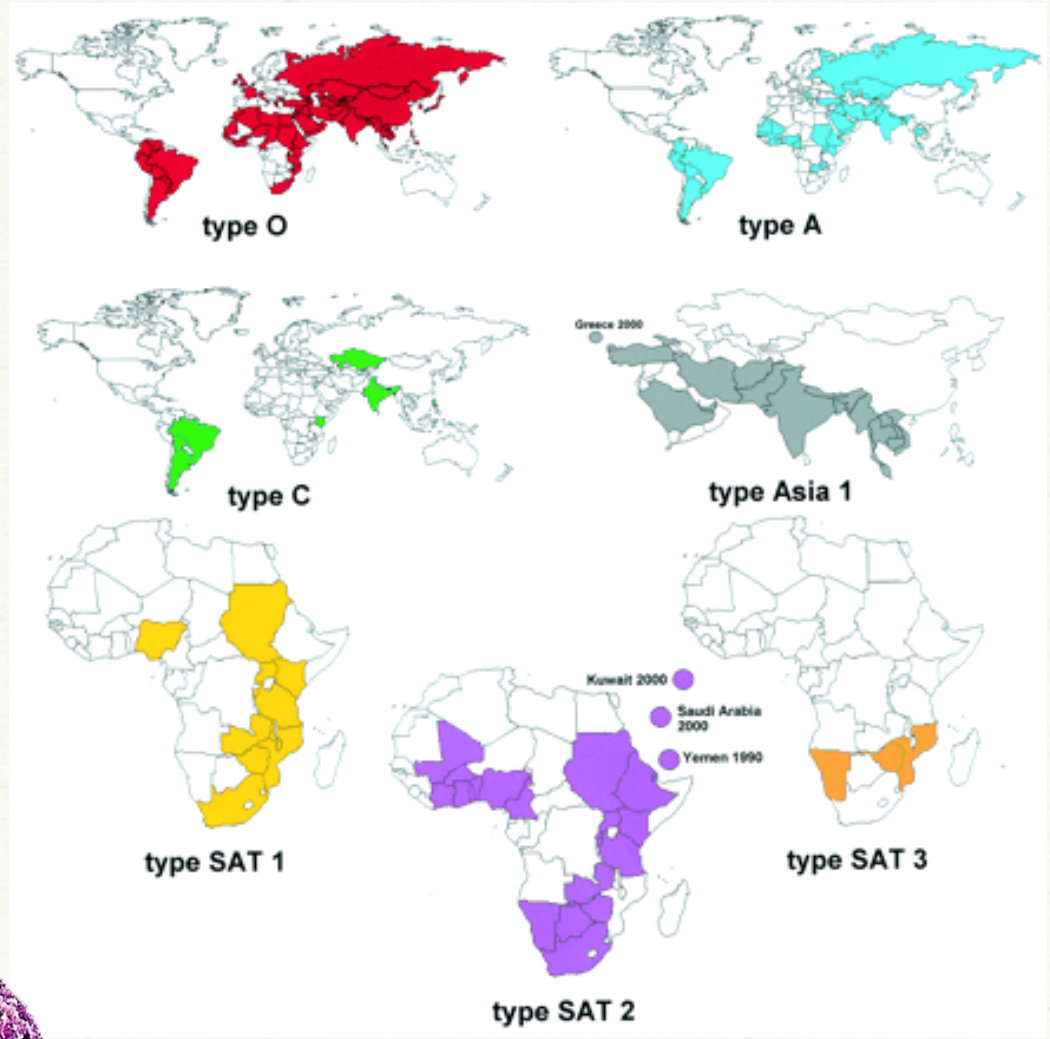


The disease is characterized by high fever that declines rapidly after two or three days, blisters inside the mouth that lead to excessive secretion of stringy or foamy saliva and to drooling, and blisters on the feet that may rupture and cause lameness.

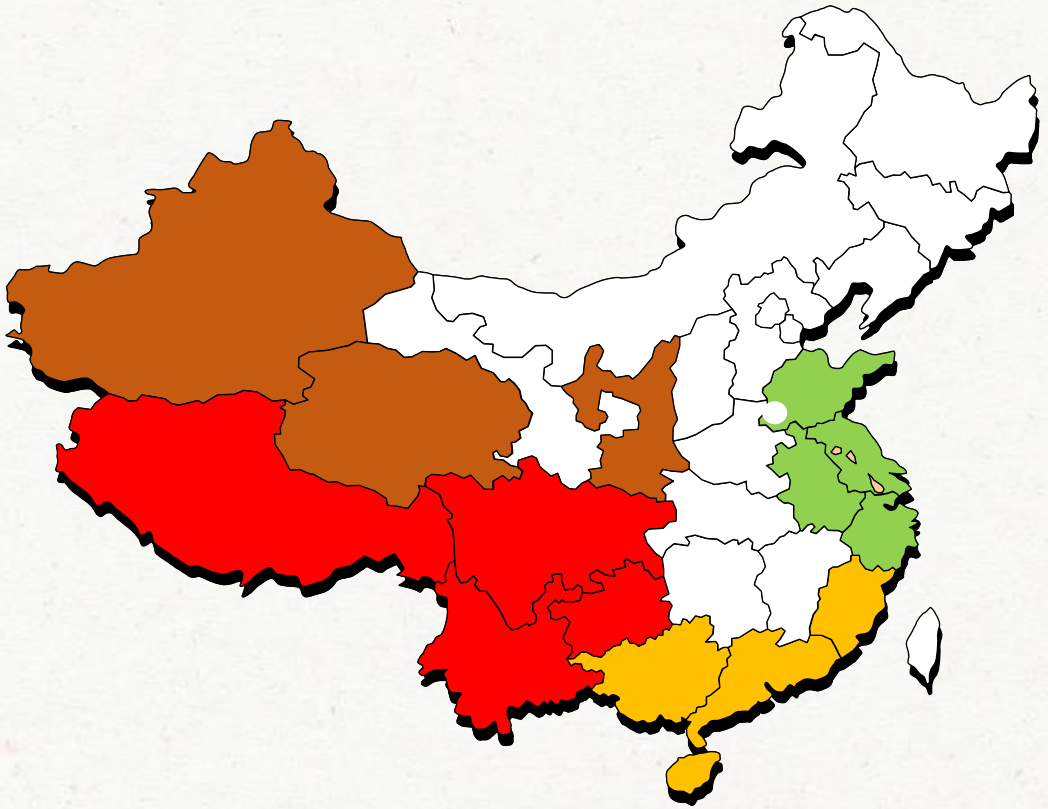


Diseases of feral swine

Foot and mouth disease



Countries in which FMD was reported to the OIE.

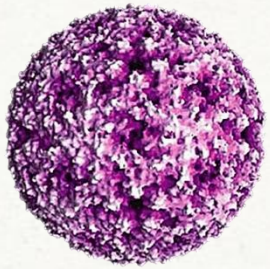


The distribution of type O in China

Diseases of feral swine

Foot and mouth disease

Feral swine may have a significant potential to spread the disease as infected animal may shed virus at high titers before clinical signs become apparent. Even after vesicles have developed on their feet, mobility may not be significantly impaired.

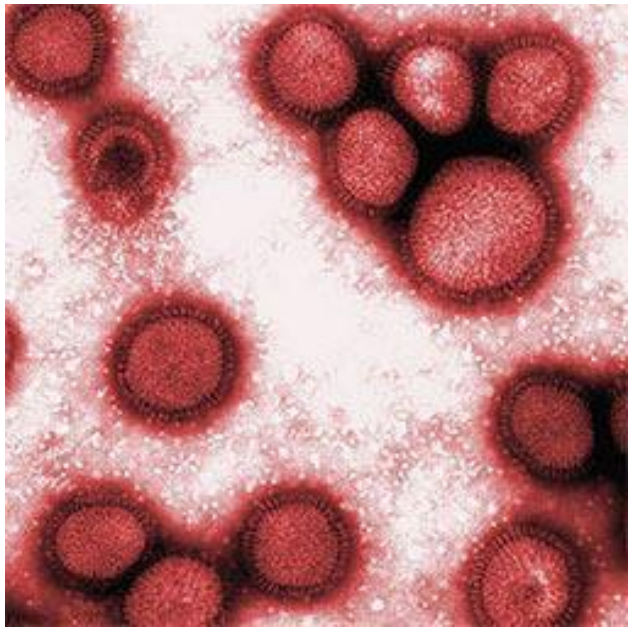


Diseases of feral swine

Classical swine fever (CSF)

Classical swine fever (CSF) is caused by an RNA virus of the genus *Pestivirus* of the *Flaviviridae* family.

Classical swine fever	
Virus classification	
Group:	GroupIV ((+)ssRNA)
Family:	Flaviviridae
Genus:	Pestivirus
Species:	Classical swine fever virus



Classical swine fever causes fever, skin lesions, convulsions and usually (particularly in young animals) death within 15 days.

Diseases of feral swine

Classical swine fever (CSF)

The polymorphism distribution Chinese swine fever virus genetic

The role of feral swine in CSF is primarily of epidemiological interest since they are regarded as a reservoir for CSF virus (CSFV) and a possible source of infection for domestic pigs.

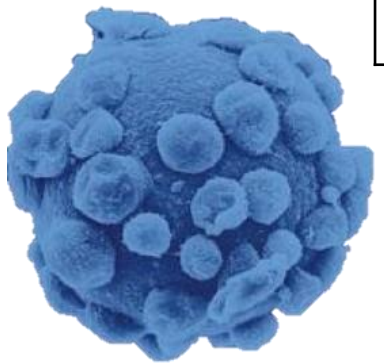
The percentages indicate the CSFV positivity rate of the province

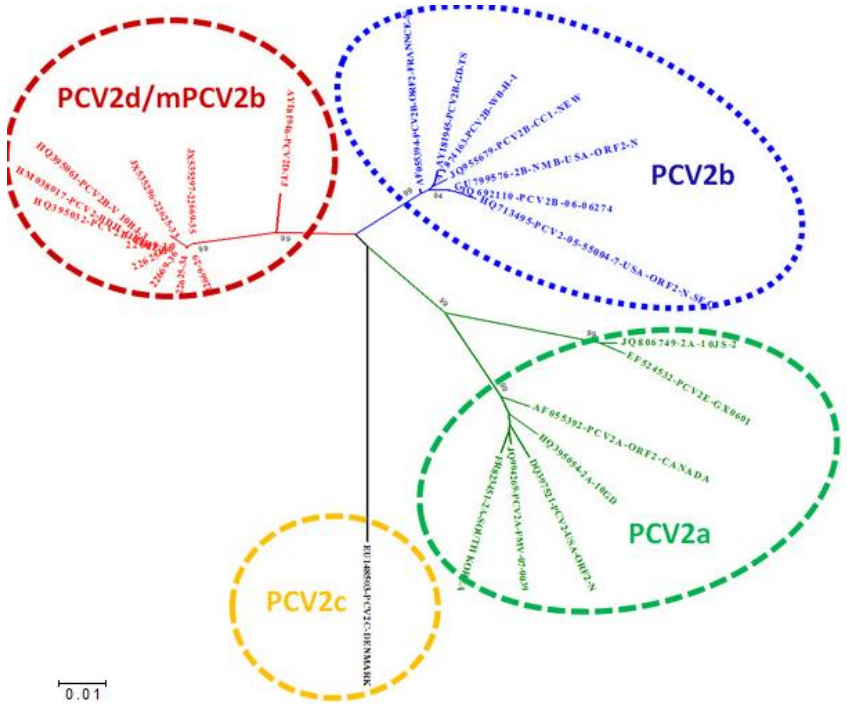
Diseases of feral swine

Porcine circovirus(PCV)

Porcine circovirus (PCV) is a single-stranded DNA virus (class II), that is nonenveloped with an unsegmented circular genome. The viral capsid is icosahedral and approximately 17 nm in diameter. PCV is a member of the virus family *Circoviridae*.

Porcine circovirus	
Virus classification	
Group	Group II (ssDNA)
Family	Circoviridae
Genus	Circovirus



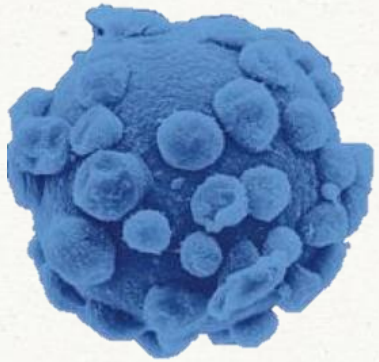


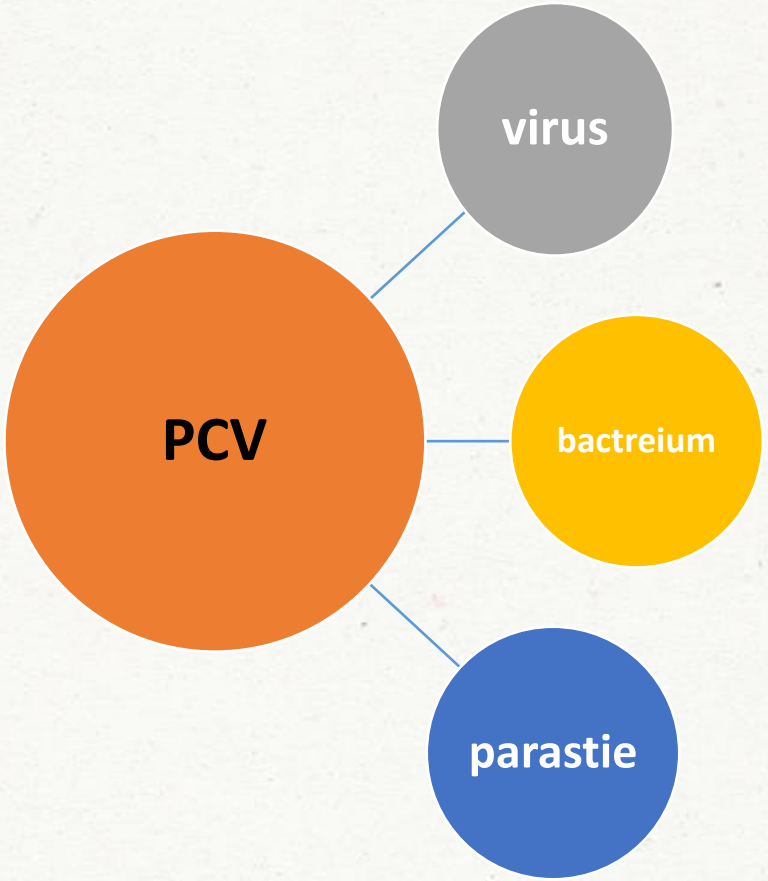
Porcine Circovirus Associated Disease is caused by porcine circovirus type 2 (PCV2)

Diseases of feral swine

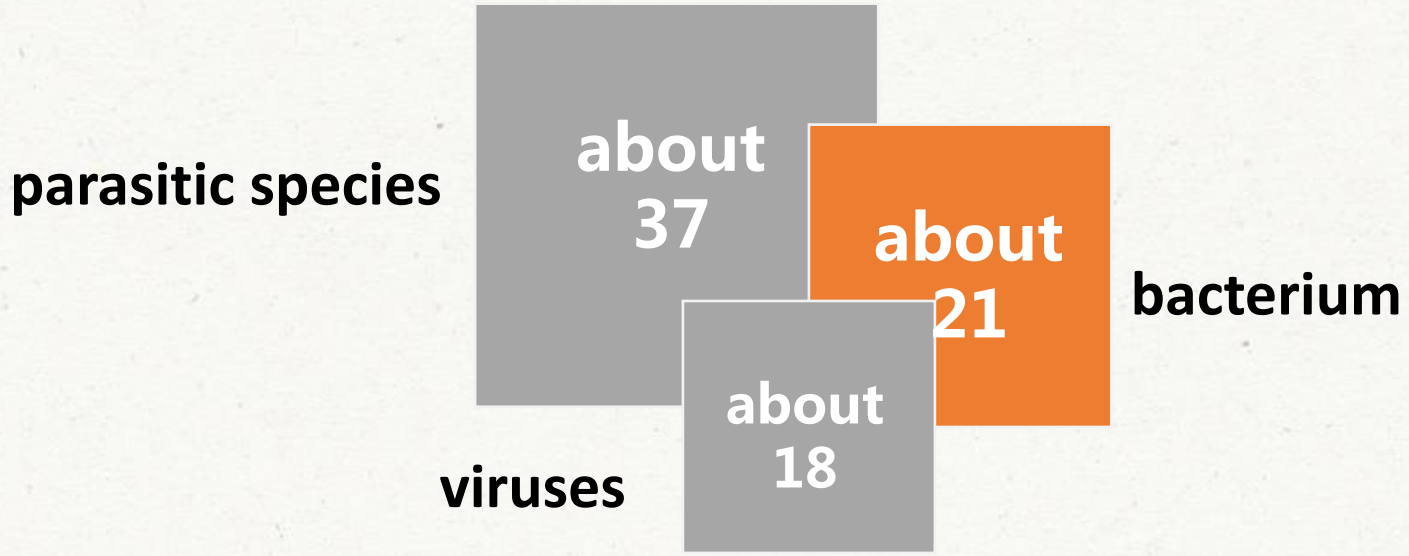
Porcine circovirus(PCV)

Recently, several other complex syndromes, including reproductive failure, enteritis, pneumonia and necrotizing dermatitis,have also been linked to PCV2 infect ion. PCVAD is further complicated by coinfections with other bacterial and viral pathogens.





Diseases of feral swine

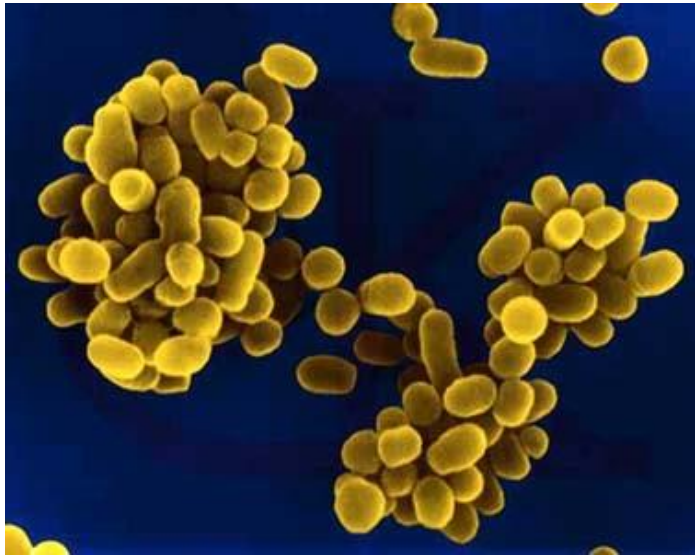


Diseases of feral swine

Brucellosis

Brucella is a genus of Gram-negative bacteria. They are small (0.5 to 0.7 by 0.6 to 1.5 µm), non-motile, non-encapsulated coccobacilli, which function as facultative intracellular parasites.

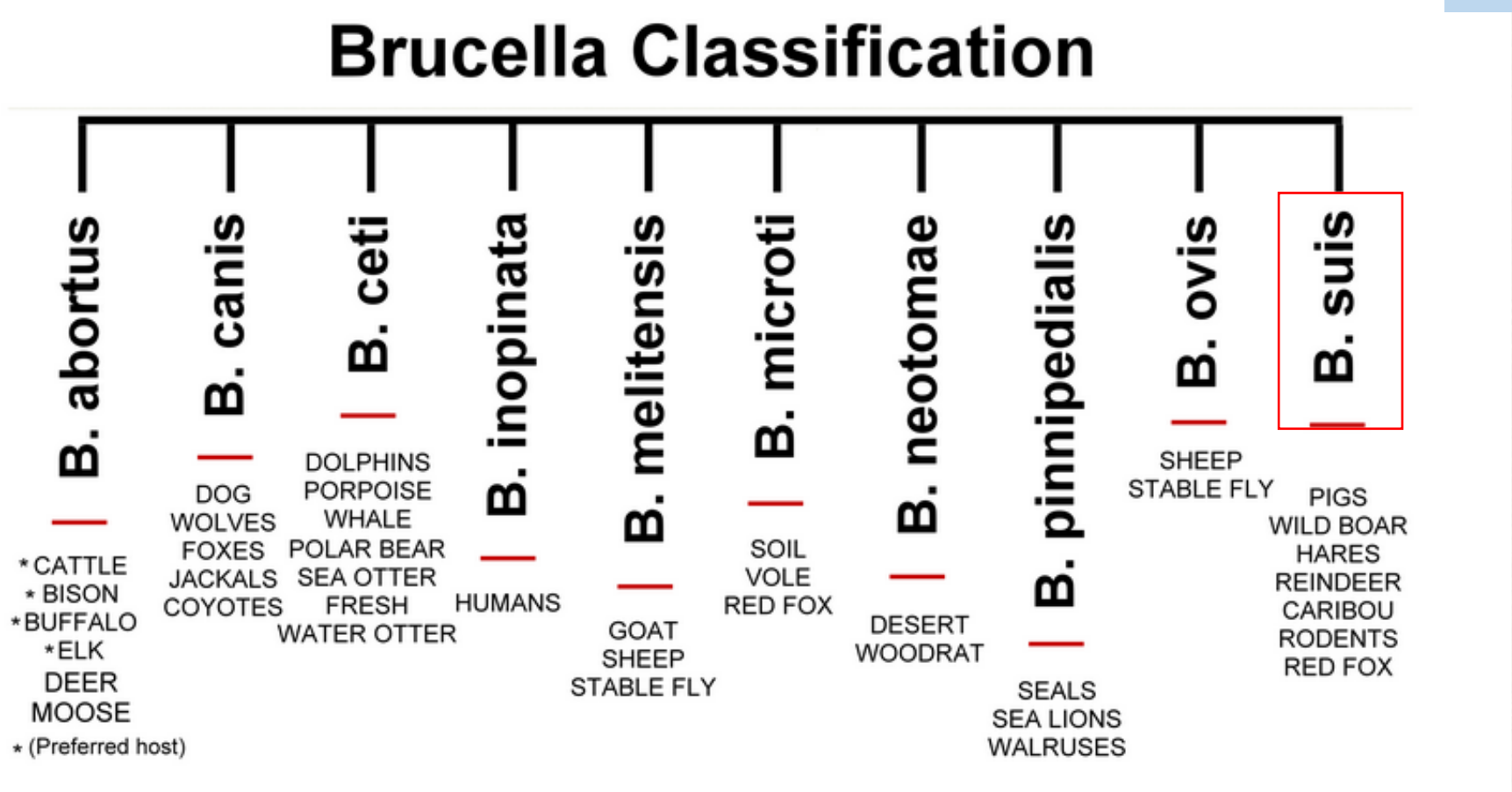
Scientific classification	
Kingdom	Bacteria
Phylum	Proteobacteria
Class	Alphaproteobacteria
Order	Rhizobiales
Family	Brucellaceae
Genus	Brucella



In the first stage of the disease, septicaemia occurs and leads to the classic triad of undulant fevers, sweating, and migratory arthralgia and myalgia.

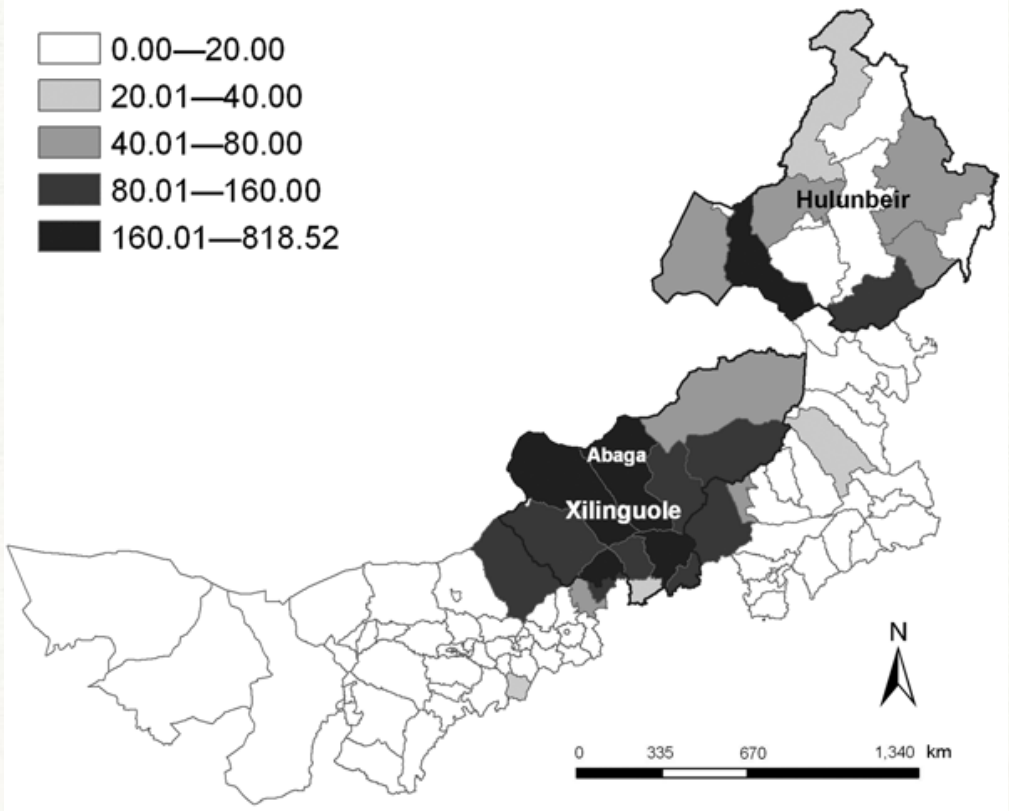
Diseases of feral swine

Brucellosis



Diseases of feral swine

Brucellosis



Brucellosis is one of the most common zoonotic infections worldwide .In China, Brucellosis is mainly distributed in northeast region.

Brucellosis is caused by ingestion of unpasteurized milk or undercooked meat from infected animals or close contact with their secretions.

Diseases of feral swine

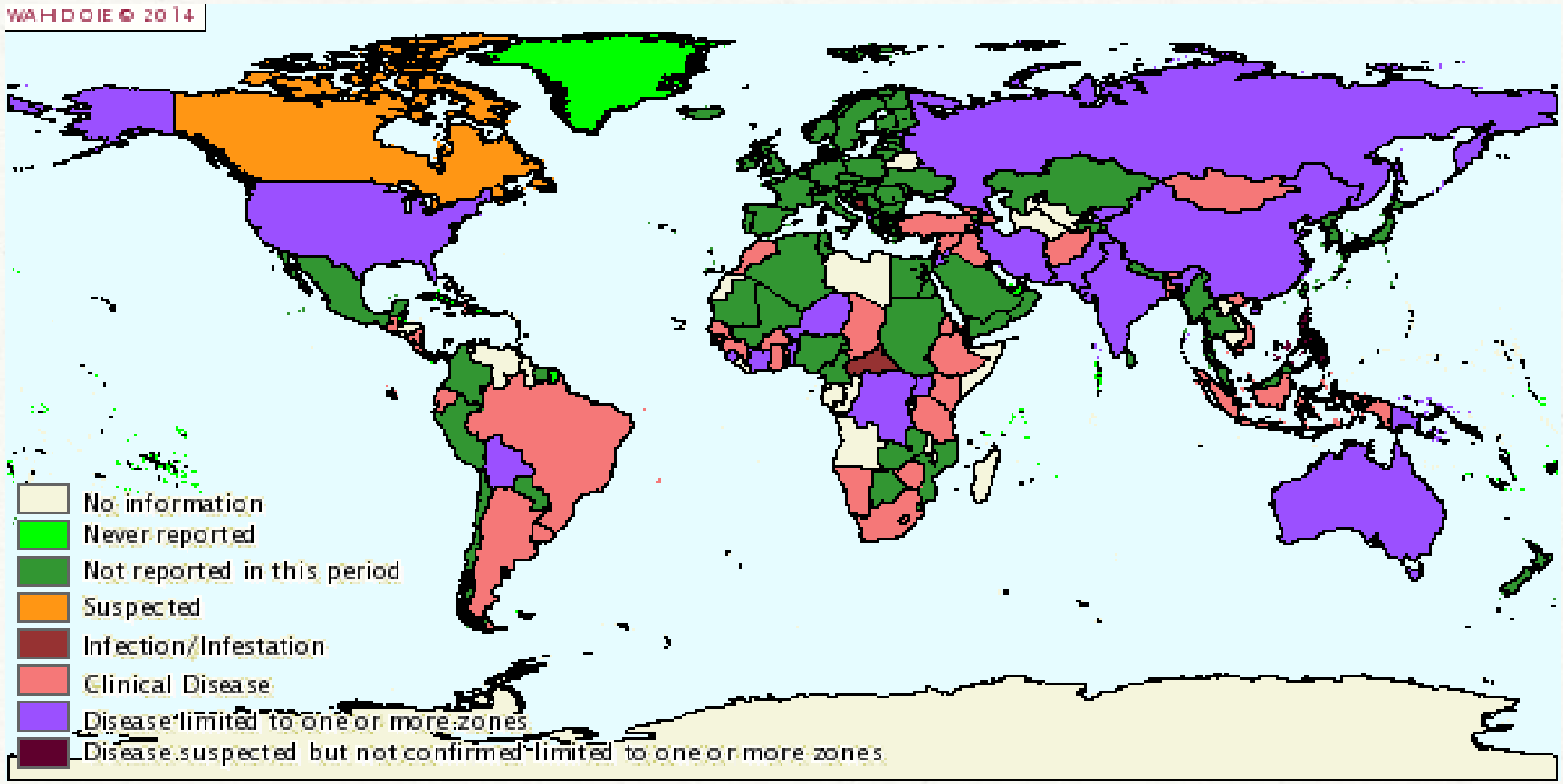
Anthrax of swine

Anthrax is an acute disease caused by the bacterium *Bacillus anthracis* .

Scientific classification	
Domain:	Bacteria
Phylum:	Firmicutes
Class:	Bacilli
Order:	Bacillales
Family:	Bacillaceae
Genus:	Bacillus
Species:	B. anthracis

Diseases of feral swine

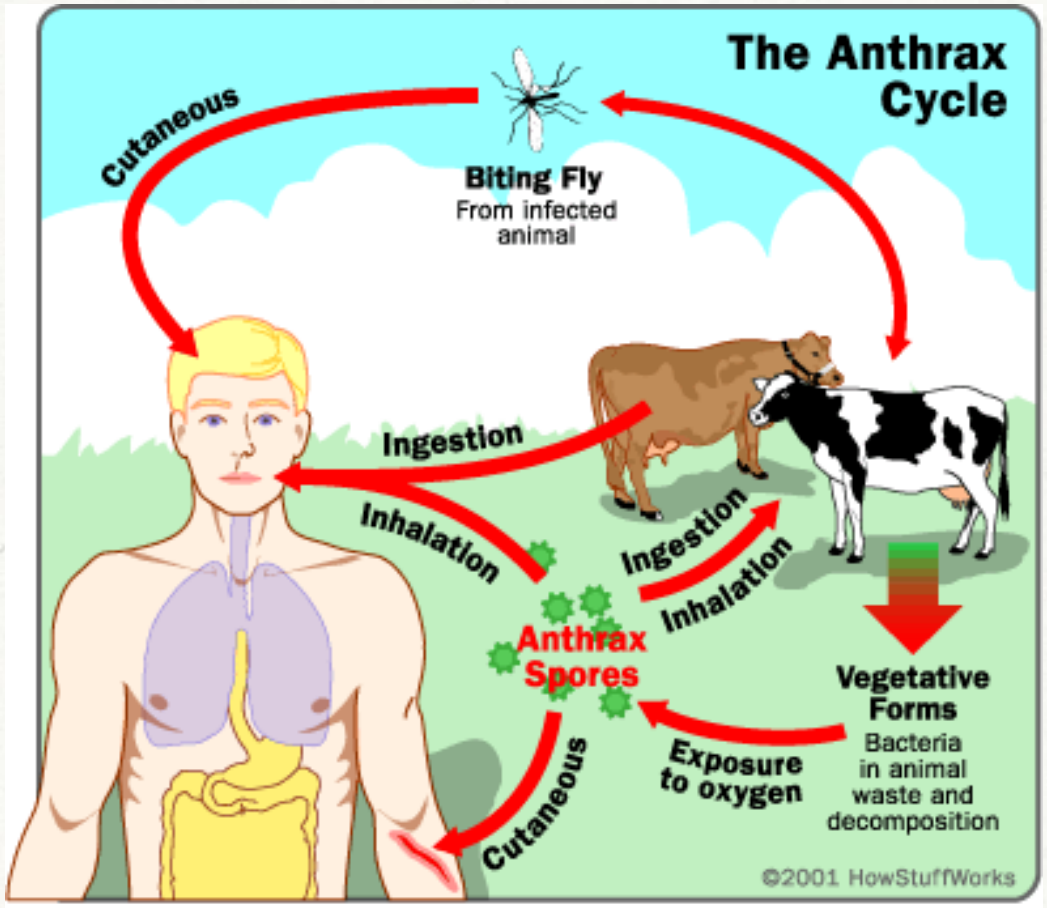
Anthrax of swine



B. anthracis can form dormant that are able to survive in harsh conditions for decades or even centuries. Such spores can be found on all continents, even Antarctica.

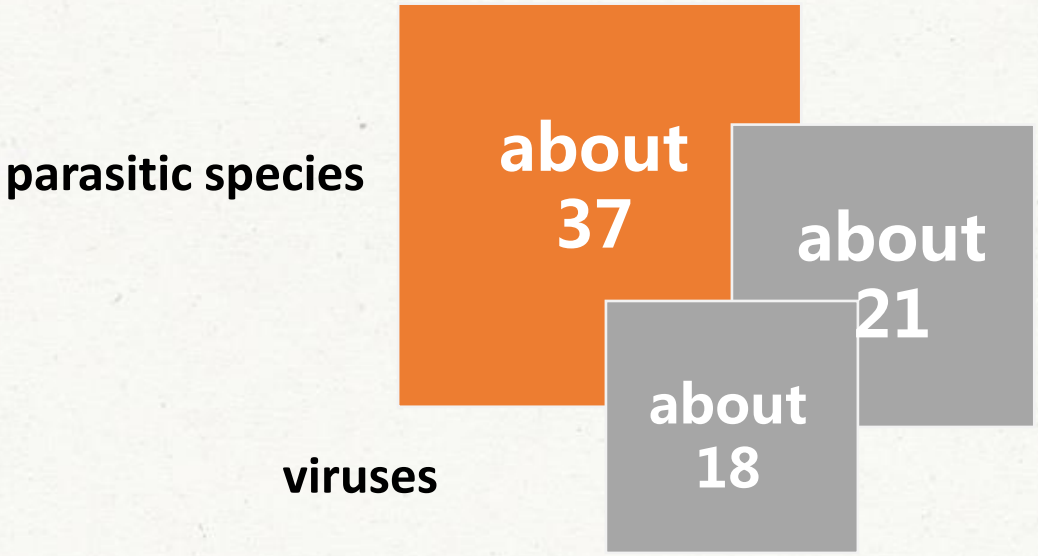
Diseases of feral swine

Anthrax of swine



A species of Bacillus can cause anthrax in humans and in animals (cattle and swine and sheep and sheep and rabbits and mice and guinea pigs) .

Diseases of feral swine



Diseases of feral swine

Trichinosis

Trichinella spiralis is a nematode parasite, occurring in rodents, pigs, bears and humans, and is responsible for the disease trichinosis.

Scientific classification	
Kingdom	Animalia
Phylum	Nematoda
Class	Adenophorea
Order	Trichocephalida
Superfamily	Trichinelloidea
Genus	Trichinella
Species	T. spiralis

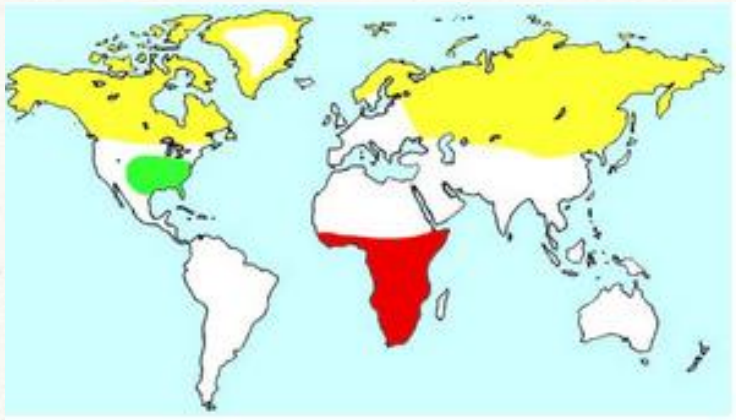
Diseases of feral swine

Trichinosis

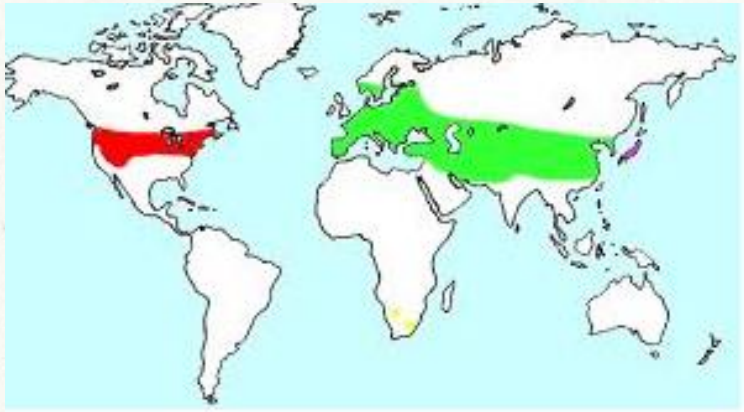
Trichinella infects humans and other mammals throughout North America, parts of South America, central America, parts of Africa, Asia, New Zealand, and Tasmania.

The maps below show the distribution of various strains of Trichinella throughout the world

Trichinella spiralis (T-1) (green) is the most common member of the genus.



Trichinella nativa (T-2) (yellow) is a Holarctic species with a very high resistance to freezing.

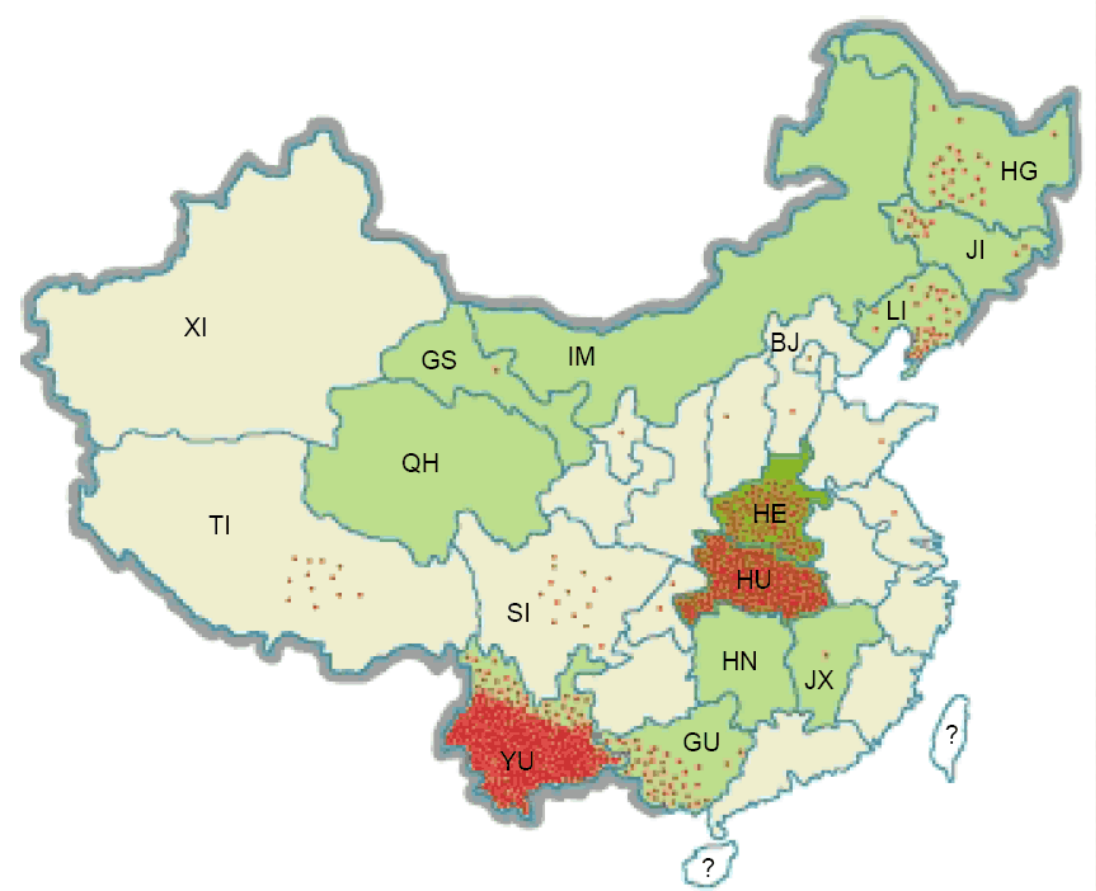


A *Trichinella* isolate, termed T-6 (red), is similar to *T. nativa.*

Trichinella pseudospiralis (T-4) (red dots) infects over a dozen species of mammals, birds and chickens.

Diseases of feral swine

Trichinosis

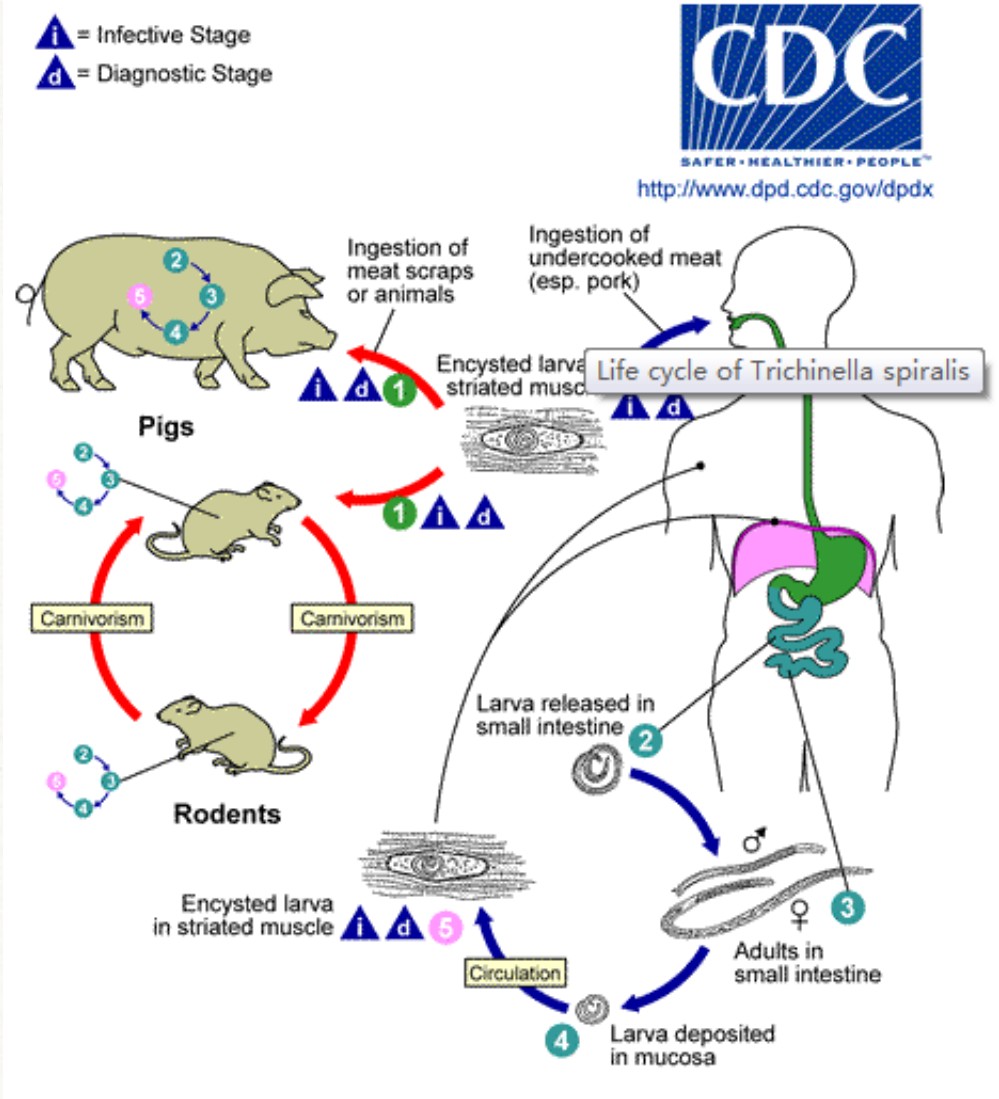


The red points show the numbers of reported or recorded human trichinellosis cases; each red point represents ≤10 cases. Green areas represent regions where a prevalence of pig trichinellosis has been recorded.

Most of the clinical (88.6%) and fatal (99.6%) cases occurred in regions (Yunnan, Guangxi and Tibet) where the habit of eating raw pork meat is common.

Diseases of feral swine

Trichinosis



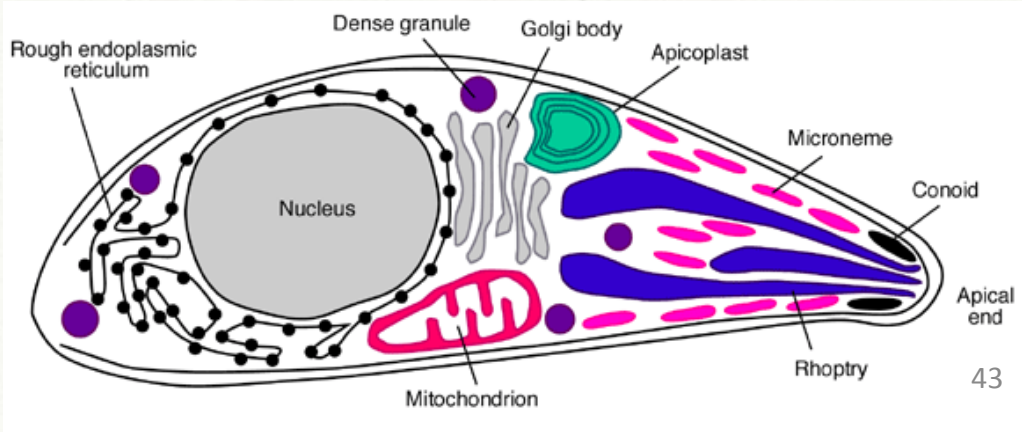
Feral swine become infected when they eat infectious cysts in raw meat, often pork or rats (sylvatic cycle).
Humans become infected when they eat raw or undercooked infected pork (domestic cycle).

Diseases of feral swine

Toxoplasmosis

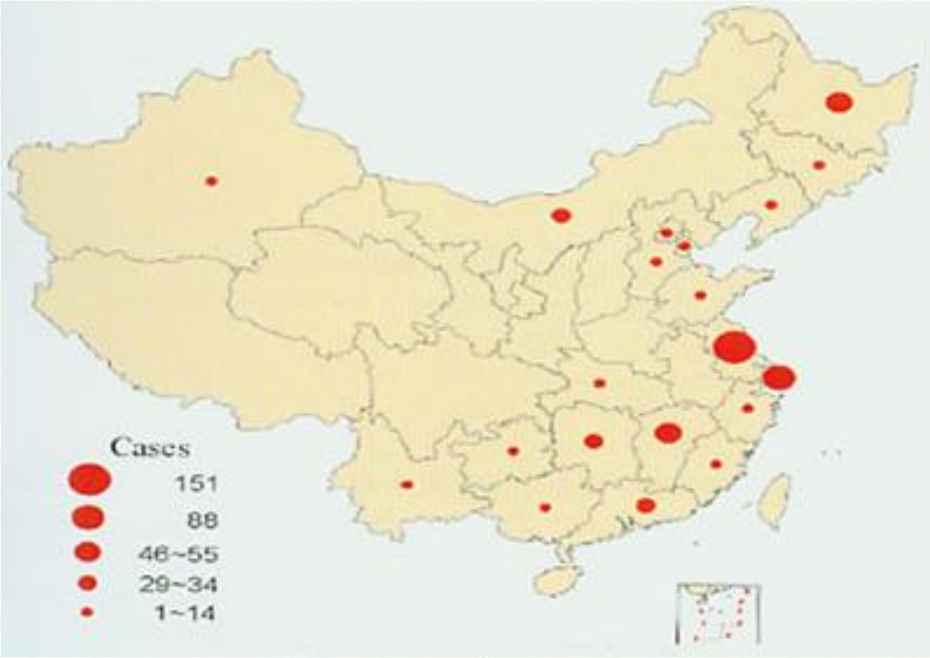
Toxoplasmosis is a parasitic disease caused by the protozoan *Toxoplasma gondii*.

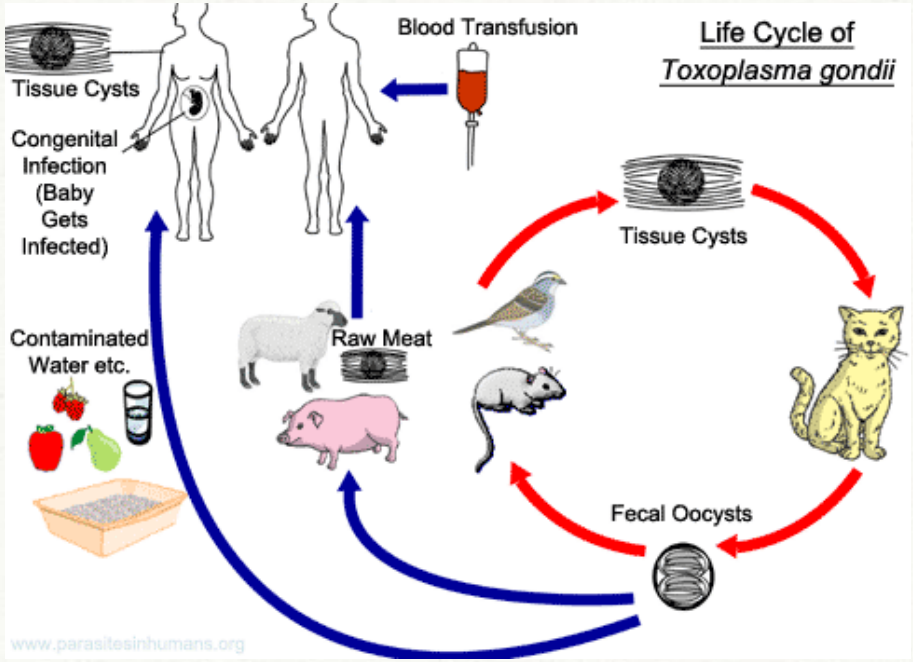
Scientific classification	
Superphylum	Alveolata
Phylum	Apicomplexa
Class	Conoidasida
Order	Eucoccidiorida
Family	Sarcocystidae
Subfamily	Toxoplasmatinae
Genus	Toxoplasma
Species	T. gondii



Diseases of feral swine

Toxoplasmosis



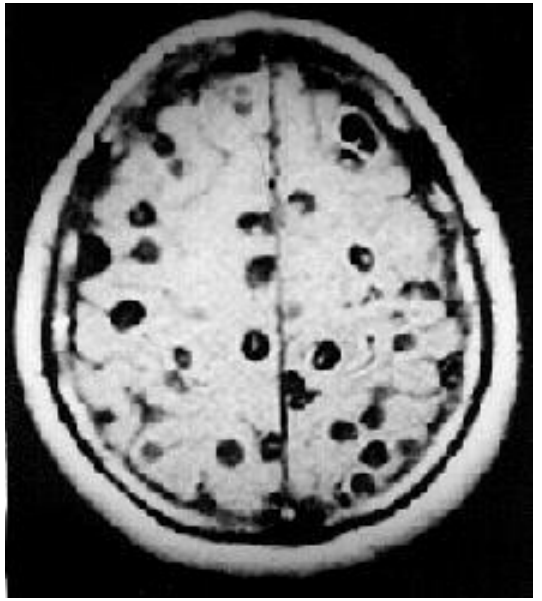


Toxoplasmosis is not a rare disease in China. Infection can transmit by ingestion of undercooked meat containing tissue cysts, especially pork, lamb, or venison and ingestion of cat (or other feline) feces contaminated with oocysts.

Diseases of feral swine

Cysticercosis cellulosae

T. solium **worms may reach a length of several meters.The scolex has four suckers, and a double crown of prominent hooks, which attach to the intestinal mucosa.**

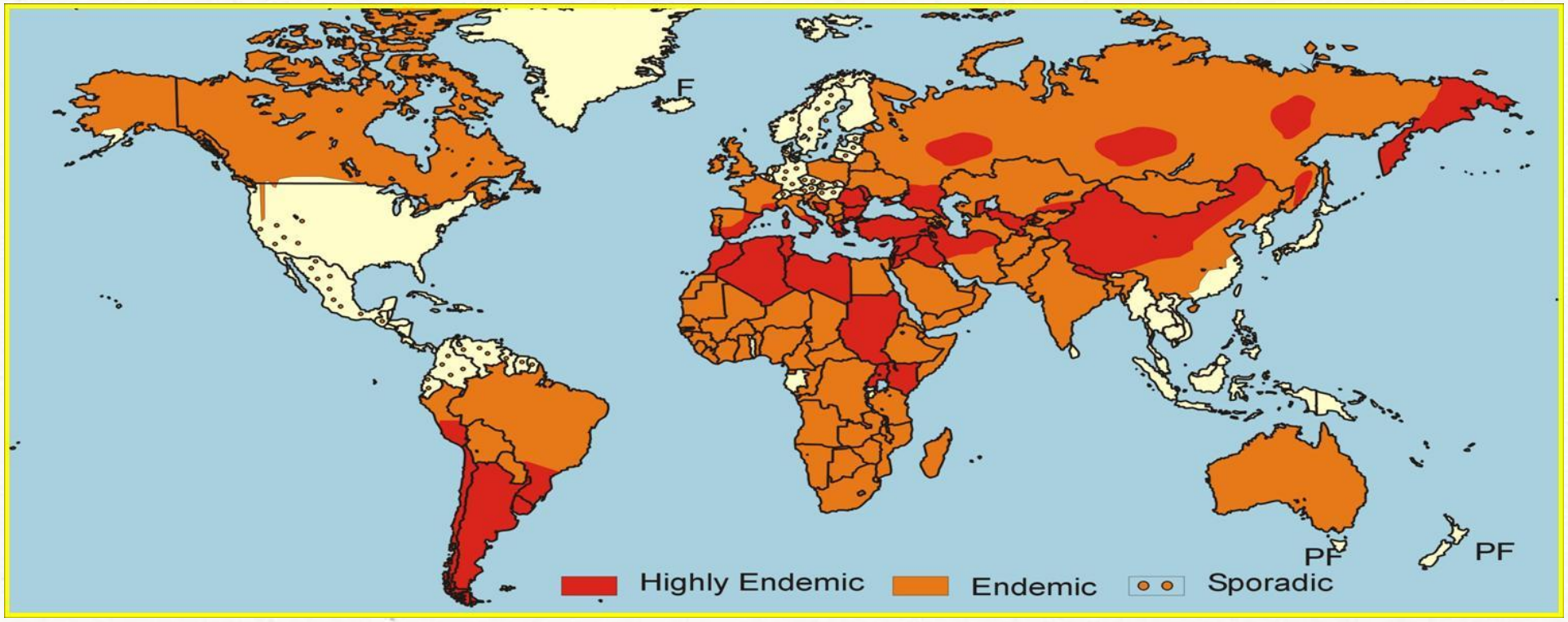


Scientific classification	
Kingdom:	Animalia
Phylum:	Platyhelminthes
Class:	Cestoda
Order:	Cyclophyllidea
Family:	Taeniidae
Genus:	*Taenia*
Species:	***T. solium***

Diseases of feral swine

Cysticercosis cellulosae

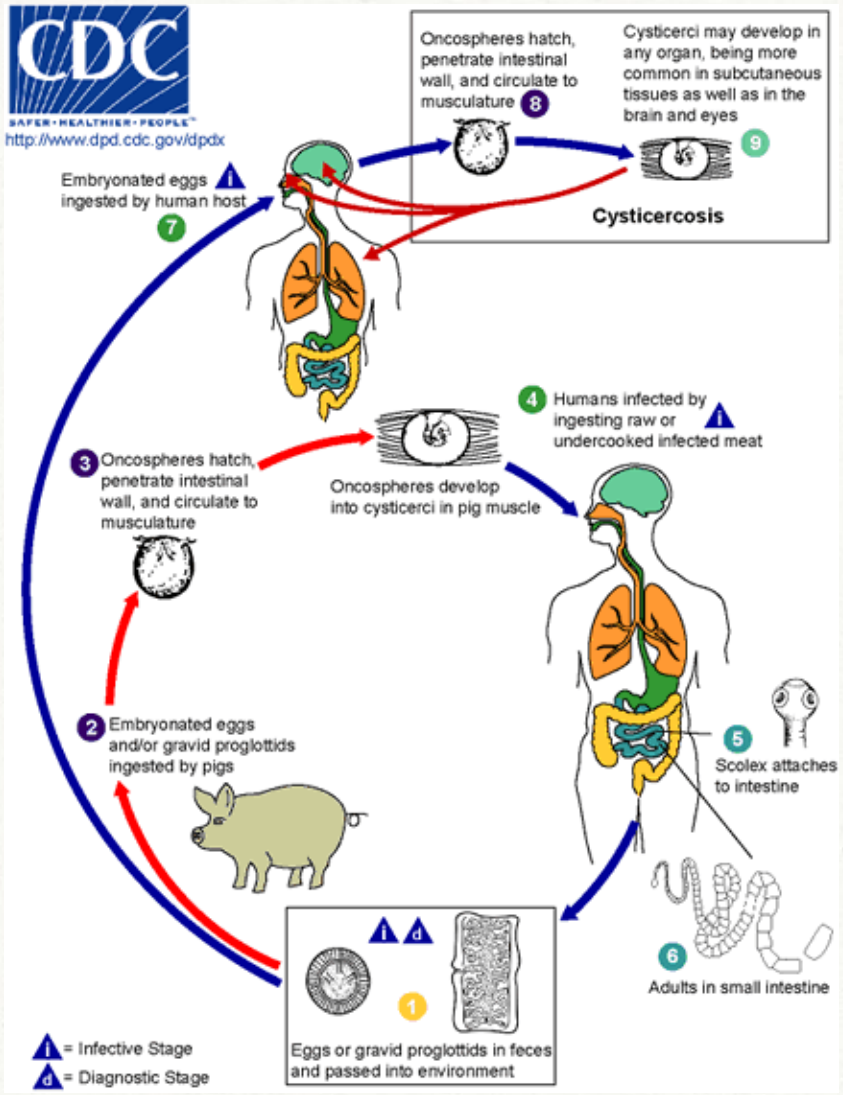
The global distribution of cysticercosis infection



Hot spots of infection, areas of high endemicity, are found in regions with high rates of pig product consumption.

Diseases of feral swine

The life cycle of the pork tapeworm.



Cysticercosis cellulosae

- **Infection with the tapeworm is strongly associated with pig husbandry along with poor hygiene.**
- **Accidentally ingested eggs can result in larva that migrate throughout the body eventually forming cysts.**

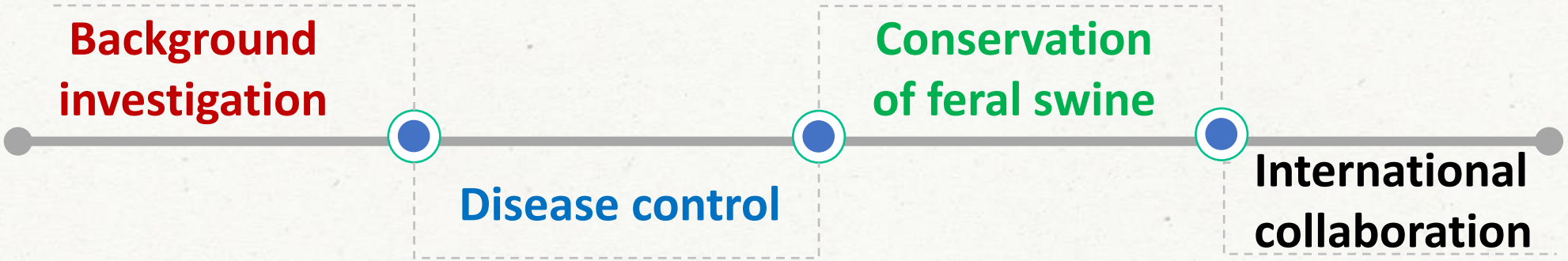
Diseases of feral swine

Feral swine has behaviors and habitat preferences that bring them into contact with wild bird, poultry, wildlife and humans and make them vectors for many diseases transfer between and among species.

Feral swine can be infected by both wildlife viruses and human viruses, and as a intermediate host in which viruses can reassort . Feral swine also serve as adaptation hosts in which wildlife viruses can mutate to become more infectious for humans.

Prevention and control strategies

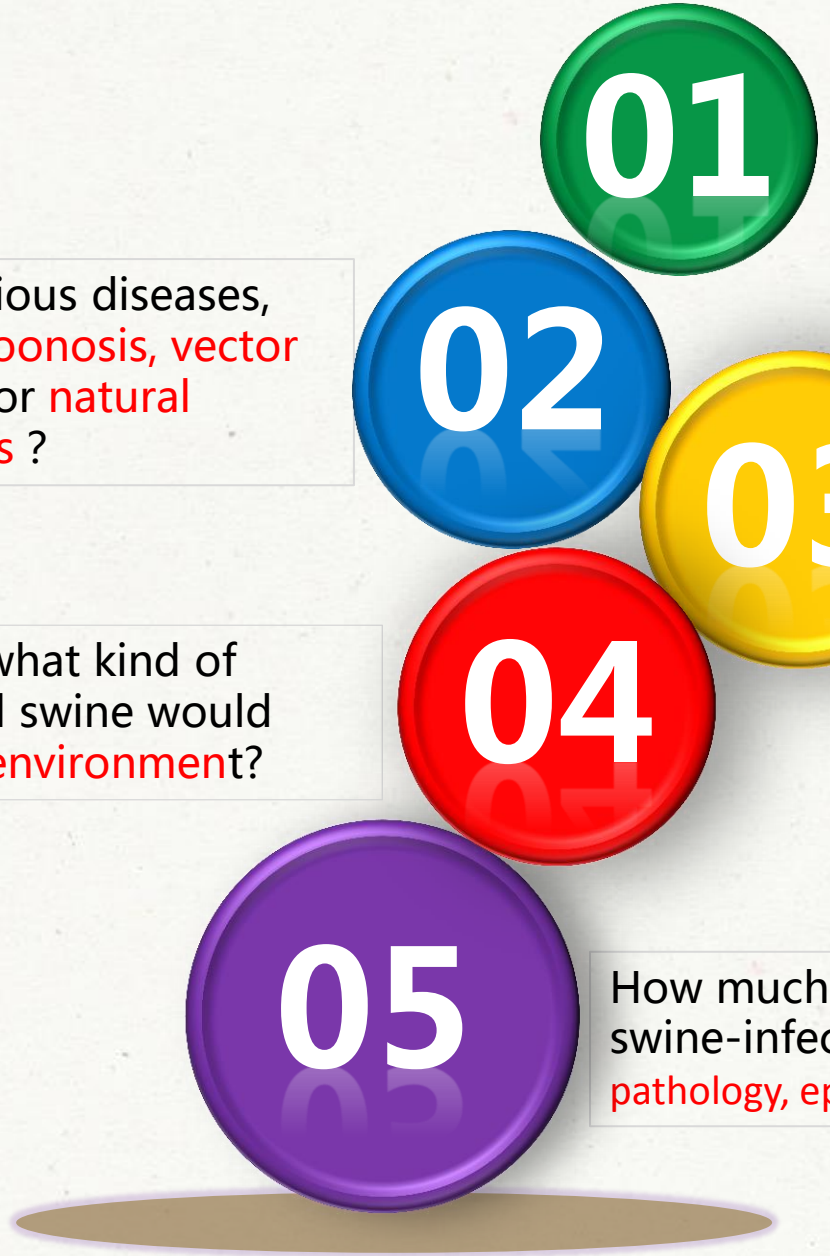
Prevention and control strategies



Prevention and control strategies

Mainly Barrier in Developing Prevention Strategy

Barriers



How much diseases, including medical disease, surgery disease, metabolic disease and infectious disease ?

Among the infectious diseases, which ones are zoonosis, vector borned diseases, or natural resources diseases ?

How many pathongens does feral swine carries? And the same with its high frequency contacteers, such as human beings?

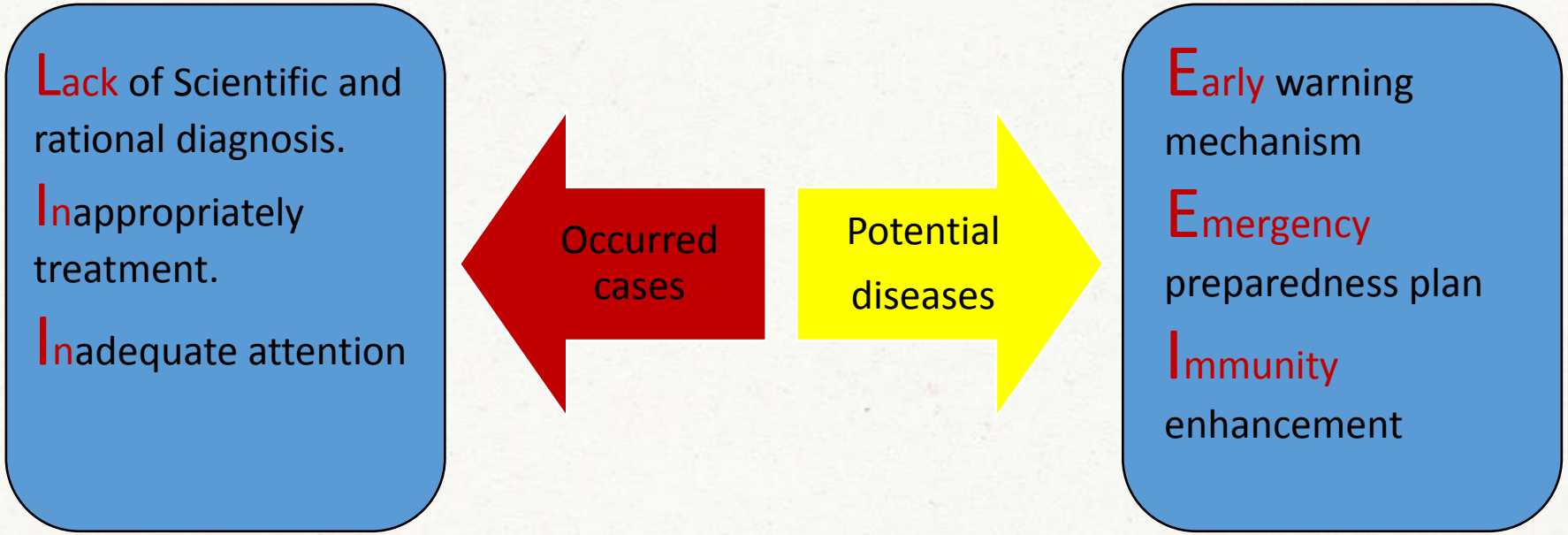
On the contrary, what kind of pathogens in feral swine would contaminate the environment?

How much do we know about the reported feral swine-infectious diseases, such as etiology, pathology, epidemiology, molecular ecology?

Prevention and control strategies

How much unknown feral swine diseases?

- Relative to goat, cow and domestic swine, we lack an systematic cognition of feral swine diseases. There exist many other unknown diseases caused by unknown disease.



Prevention and control strategies

Among the infectious diseases, which ones are zoonosis, vector-borne diseases, or natural resources diseases?

- Infectious disease can be divided into endogenous infection and exogenous infection.
- For exogenous infection, it is pivotal important to clarify the source of infection.

Zoonosis	Vector Borne Disease	Wildlife Borne Diseases	Other Diseases
Some diseases can be transmitted to feral swine by human	Diseases can be transmitted to by mosquito and bite	feral swine could contact with mouse, bat, and many other animals, **unexpected disease may infect feral swine**	Endogenous infection, mostly caused by conditioned pathogen

Prevention and control strategies

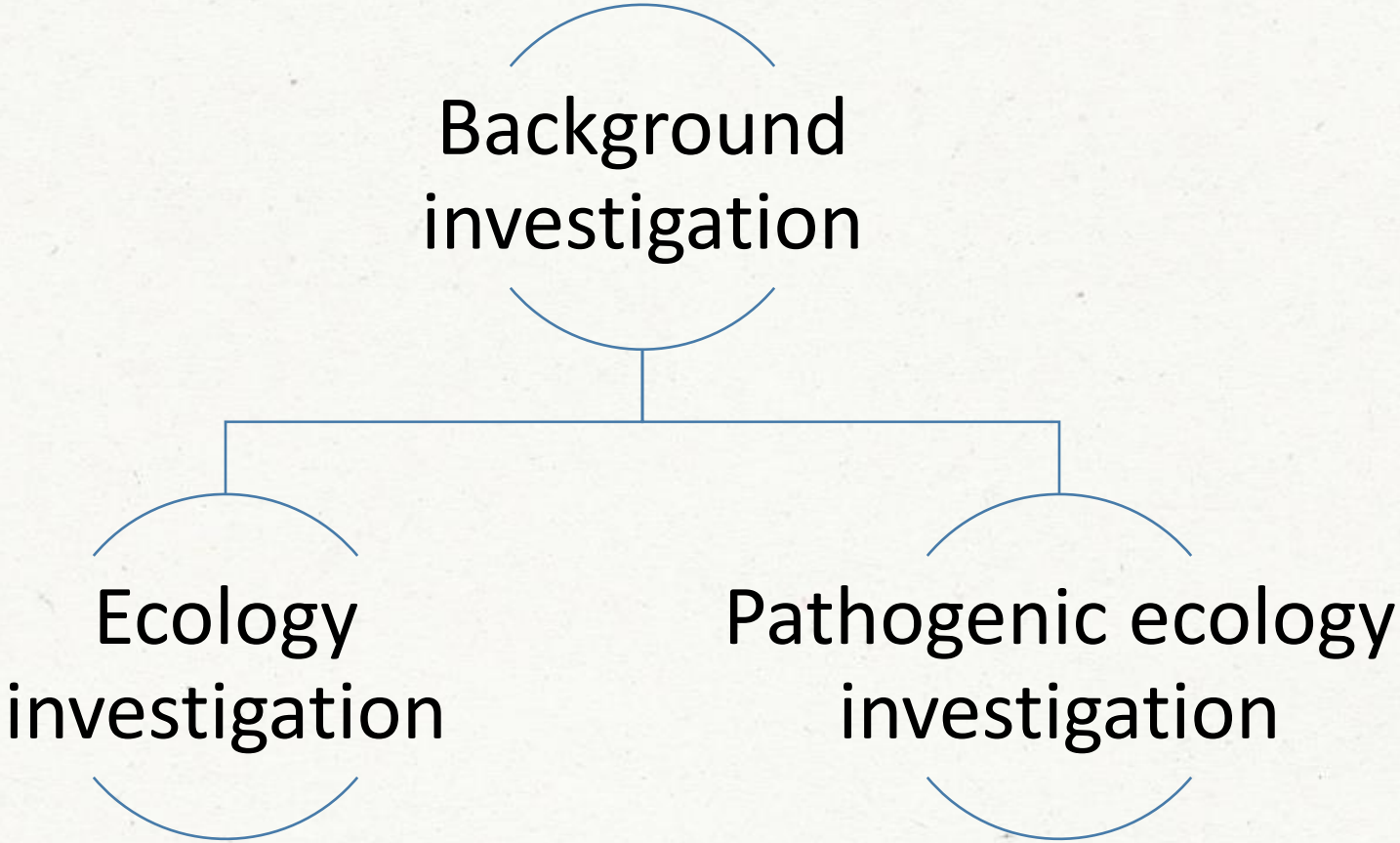
Which factors affect feral swine diseases, and How this factors affect feral swine diseases?

Land modification	Vegetation patterns changes	Vetor and host special dynamics
microclimates	human contact with domestic and wild animals	Population density

Crucial factors in disease ecology

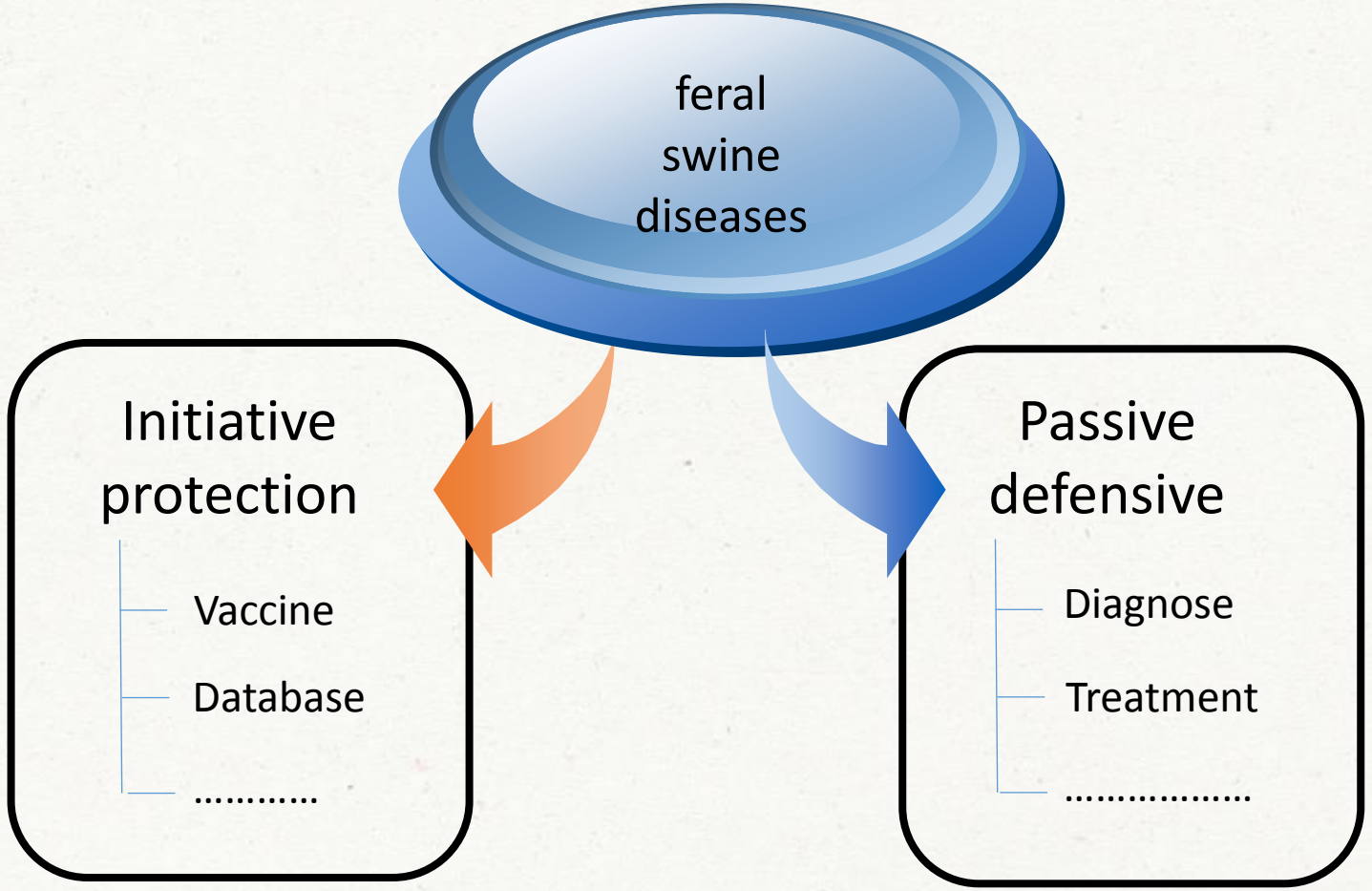
Prevention and control strategies

What do we know about the reported feral swine-infectious diseases, such as etiology, pathology, epidemiology, molecular ecology?



Prevention and control strategies

Strategy-making



Prevention and control strategies

Goal

02

Secondly

Rapid detection, rapid diagnose and rational cure.

01

Firstly

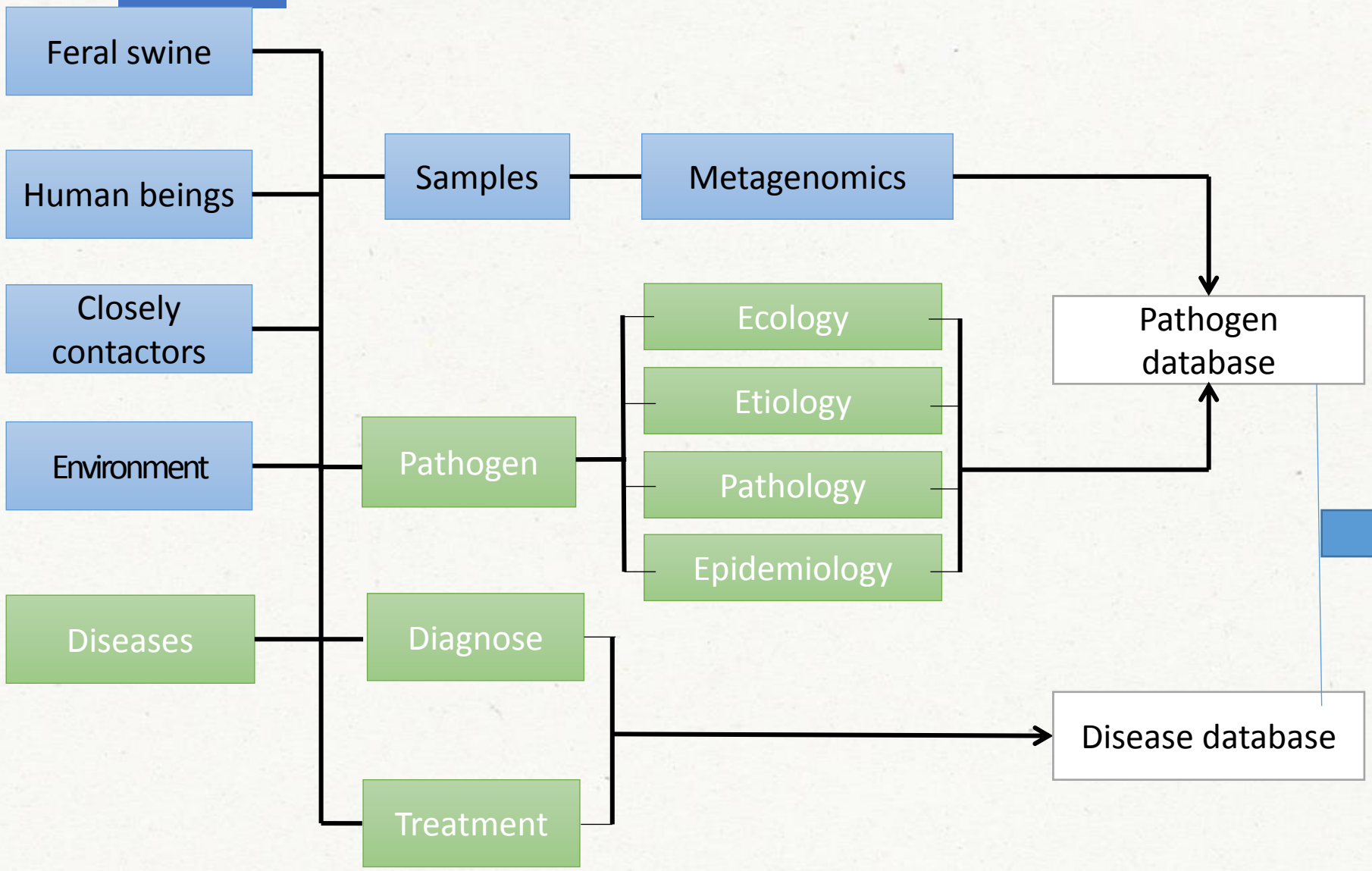
developing a feral swine-infected disease database

03

Thirdly

Early warning system of feral swine disease.

Prevention and control strategies



Initiative protection

Vaccine.

Early warning of certain disease.

Take action on its closely contactors and environment.

Passive defensive

Rapid diagnose

Rational use of drugs

Develop new drugs

Prevention and control strategies

Rapid diagnose

- When a unknown disease occurred, how much dose it spends to give a correct diagnose?
- Rational use of drugs

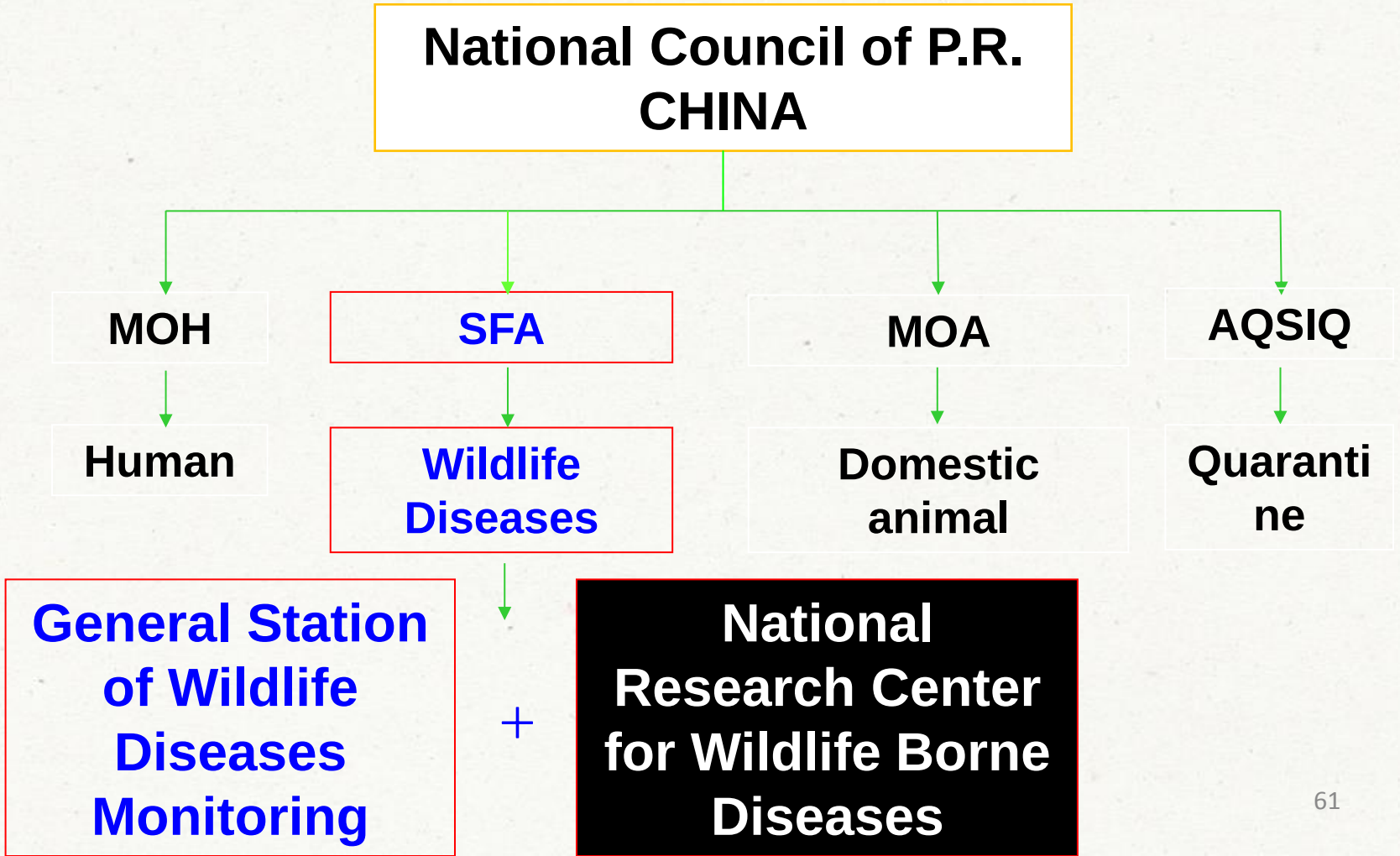
Molecular diagnose	Serum diagnose	Etiology diagnose
PCR	Monoclonal antibody	Biochemistry
Real-time PCR	Multiclonal antibody	BD Phoenix
LAMP	Colloidal gold test strip	SPR
Gene chip	PBA	

Prevention and control strategies

Division of wildlife borne diseases management

Surveillance of disease

Nationwide wildlife-borne disease surveillance



Prevention and control strategies

Surveillance of disease

Establishing monitoring station network

NMS 350
PMS 768
CMS > 2000

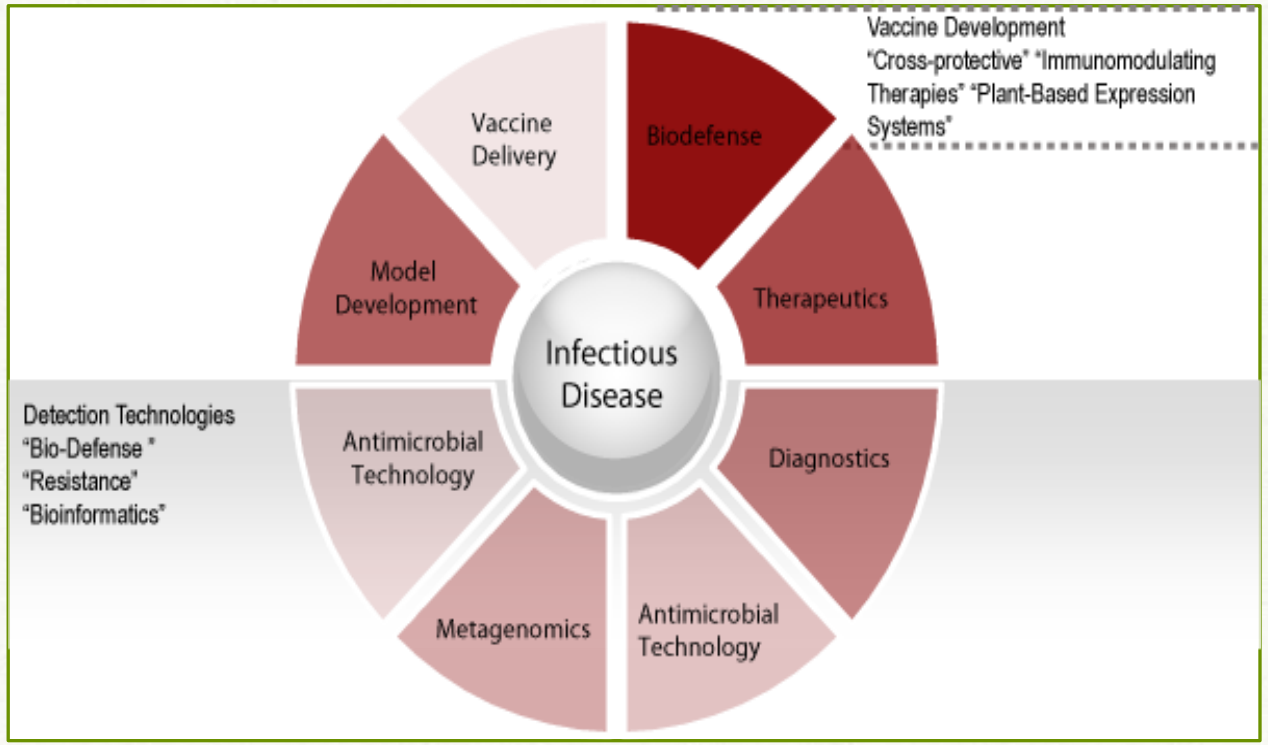
Prevention and control strategies

Manage the population of feral pigs

Establish the corresponding laws	Investigate population changes in feral pigs	Controlled hunting
• Feral swine belongs to the animals under state protection (category ii).	• Find the quantities of the optimal stock and the optimal harvest	• Keep the balance between their pest and resource status

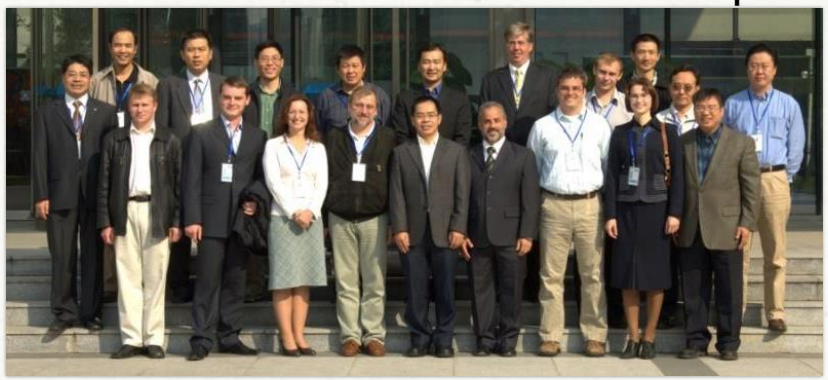
Prevention and control strategies

- The prevention and control of feral swine diseases is an tough work, which needs closely cooperation of different research department.



Prevention and control strategies

- The 1st Workshop on Regional Surveillance and Research for Wildlife-Borne Diseases
- The 2nd Workshop on Regional Surveillance and Research for Wildlife-Borne Diseases
- The 3rd Workshop on Regional Surveillance and Research for Wildlife-Borne Diseases
- The 4th Workshop on Regional Surveillance and Research for Wildlife-Borne Diseases
- The 5th Workshop on Regional Surveillance and Research for Wildlife-Borne Diseases
- The 6th Workshop on Regional Surveillance and Research for Wildlife-Borne Diseases
- The 7th Workshop on Regional Surveillance and Research for Wildlife-Borne Diseases



Prevention and control strategies

Highlighted points

- We should protect the total ecosystem, not only focus our eyes on the feral swine itself. Only a harmony ecosystem supports healthy fairy in the natural reserve.
- The feral swine closely contactors, for example the migrating birds and other animals, should not carry the pathogen that can be sensitive to feral swine.
- For wild feral swines, it is important to perform etiology investigation in there habitat.
- Passive defensive against infectious disease is far from enough.

Prevention and control strategies

In order to solve those highlighted points , China has marched two national plans.

National terrestrial wildlife resources survey for the second time

National medium and long term plan for animal disease prevention and control

Prevention and control strategies

National terrestrial wildlife resources survey for the second time

The purpose of the wildlife resources investigation is to provide a scientific basis of protecting the development of wildlife resources in China. The wild-life resources investigation, on one hand, is the necessary measure to fulfill the need for the relevant departments to formulate the macroscopic policy, perform international obligations, carry out the international communication. On the other hand, it is essential to carry out the law of wildlife protection of PRC.

Prevention and control strategies

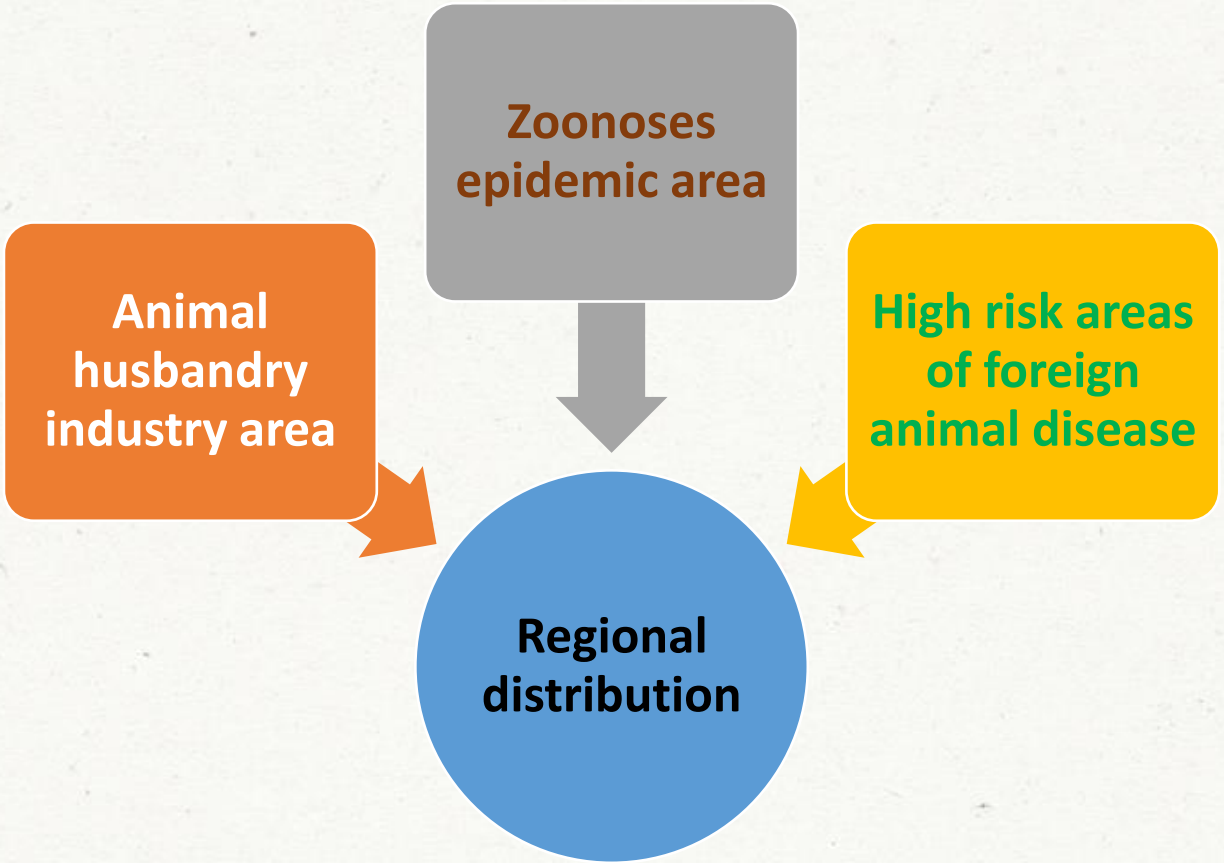
National terrestrial wildlife resources survey for the second time

From 2011 to 2015

Prevention and control strategies

National medium and long term plan for animal disease prevention and control

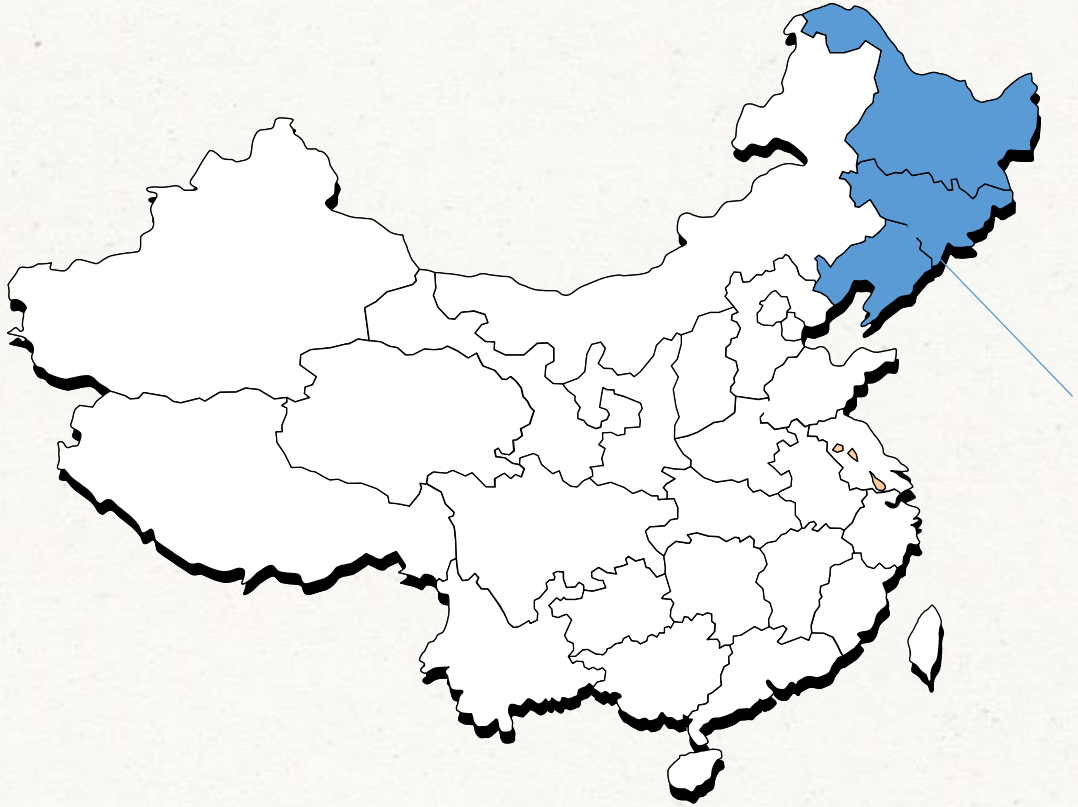
The state implements regionalization management for animal epidemics.



Prevention and control strategies

National medium and long term plan for animal disease prevention and control

Animal husbandry industry

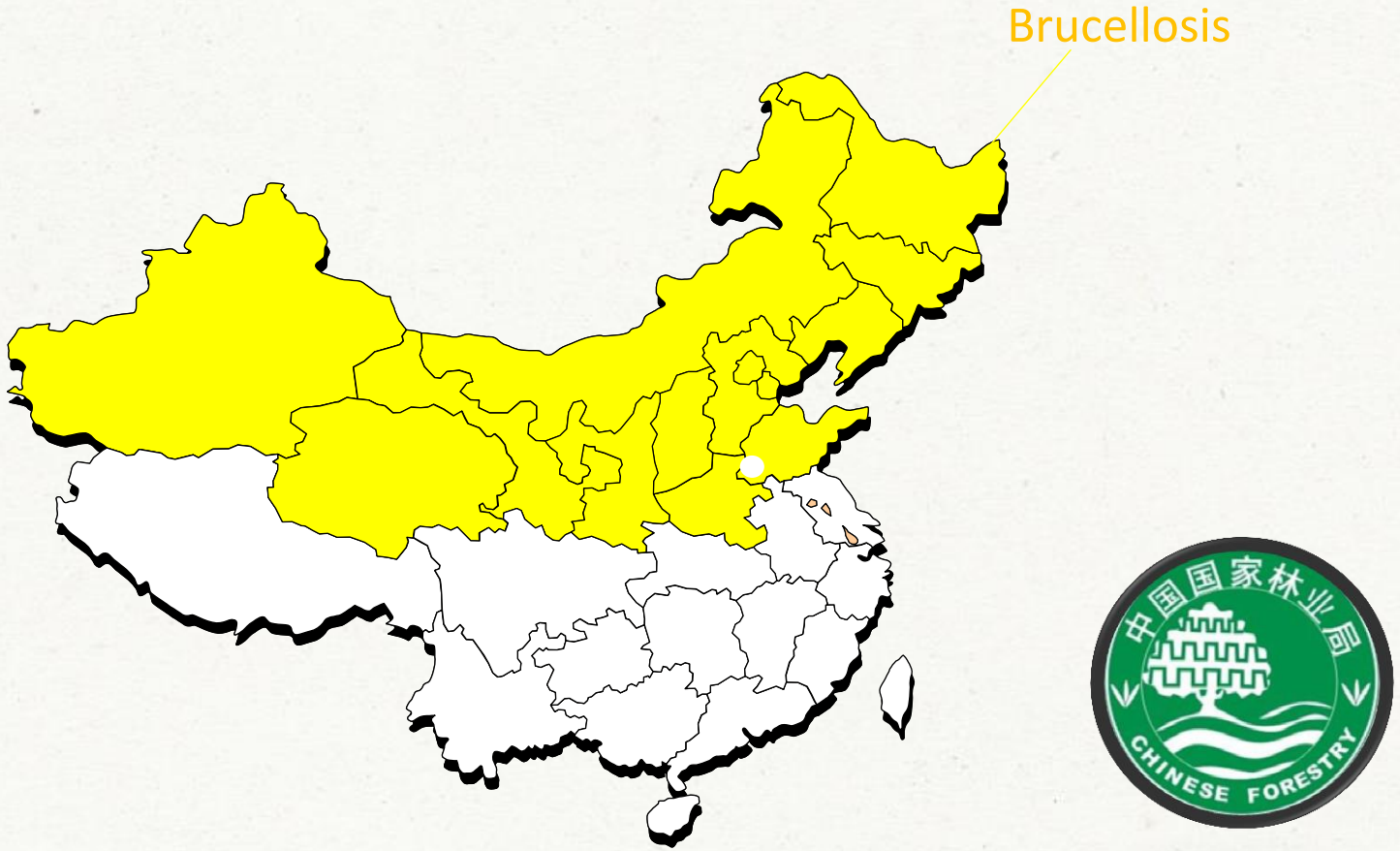


FMD、PRRS、Classical swine fever

Prevention and control strategies

National medium and long term plan for animal disease prevention and control

Zoonoses epidemic area

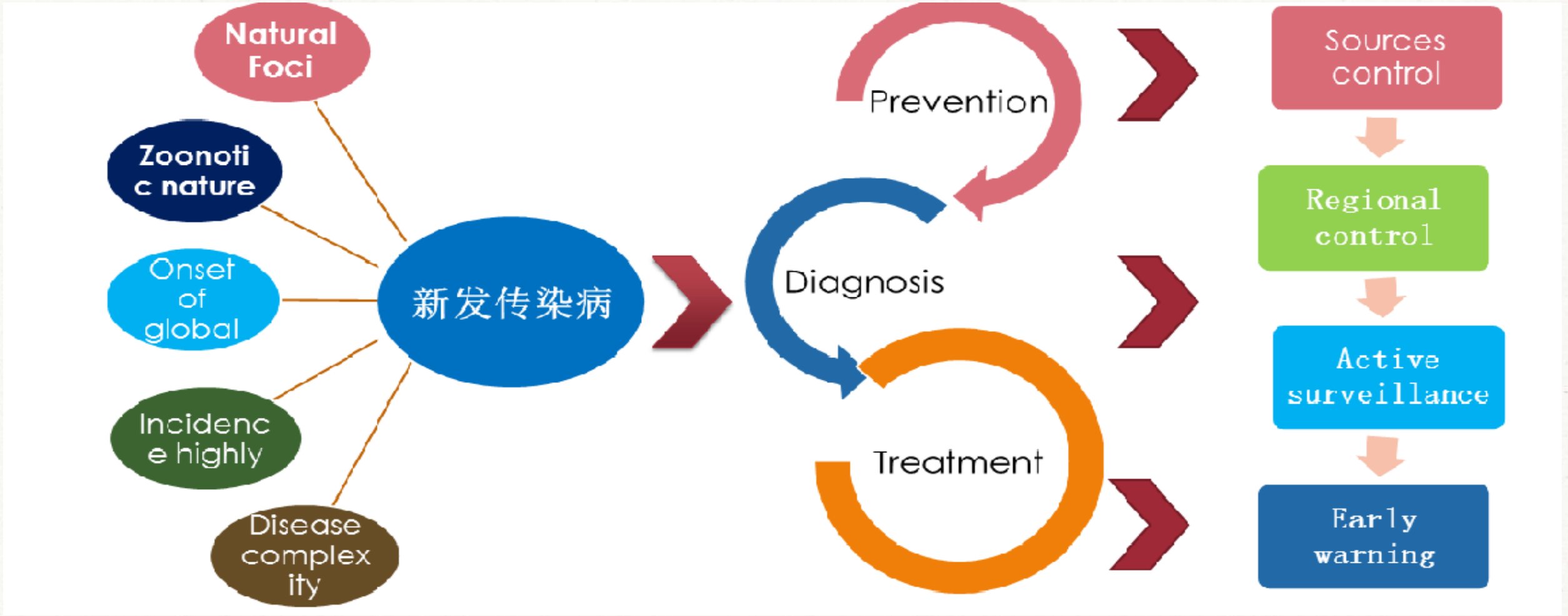


Prevention and control strategies

National medium and long term plan for animal disease prevention and control

High risk areas of foreign animal disease

Feral Swine Diseases– Opportunities&Challenges

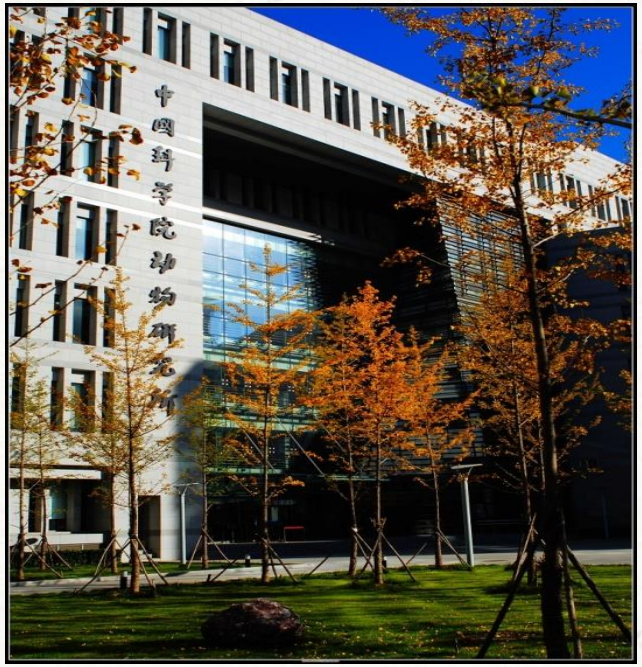


Our goals

- We can do more for feral swine infectious diseases prevention and control
- We can do more for public health safety and biodiversity safety
- We can make a contribute for One World One Health

Welcome to Beijing!

Hehx@ioz.ac.cn



Your company

Thanks For Your Attention

By *Hongxuan He*