Overview of Plague Epidemiology in Asia

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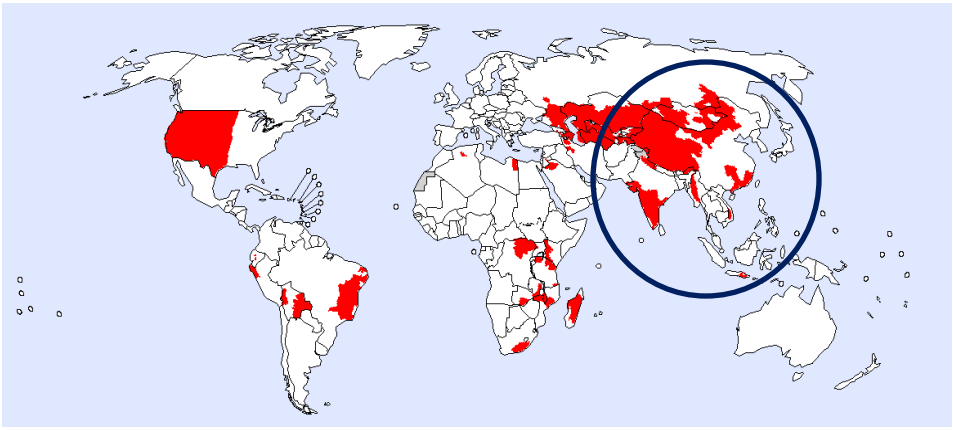
Plague – Part of human history!

- Plague has been responsible for widespread pandemics with high mortality in the history of human civilization
  - "Justinian plague" spread around the Mediterranean Sea in the 6th century
  - "Black Death" started in Europe in the 14th century (Europe, Asia and Africa)
  - **The third pandemic started in China in the 19th century and spread throughout the world (Asia, Europe, Africa and America)**
- Black death caused an estimated 75–200 million deaths, approximately half of them in Asia and Africa and the other half in Europe

Plague: Reemerging disease in Asia!

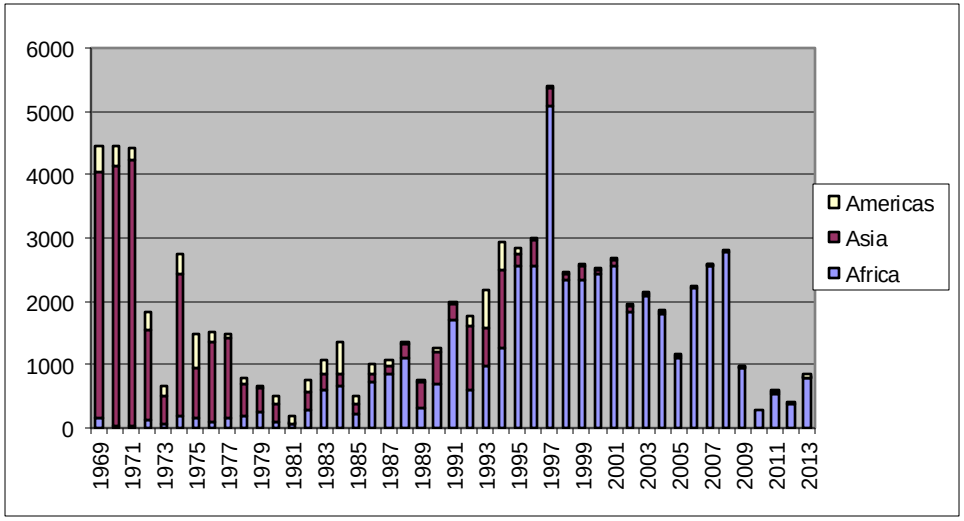
- Plague is often classified as a problem of the **ancient disease** that is **not likely to disappear**
- Following the reappearance of plague during the 1990s in several countries, plague has been categorized as a **re-emerging disease**
- Many countries have **dismantled a surveillance system for plague** because of a **lack of funds and periodic outbreak absenteeism**

Global distribution of natural plague foci (2016)



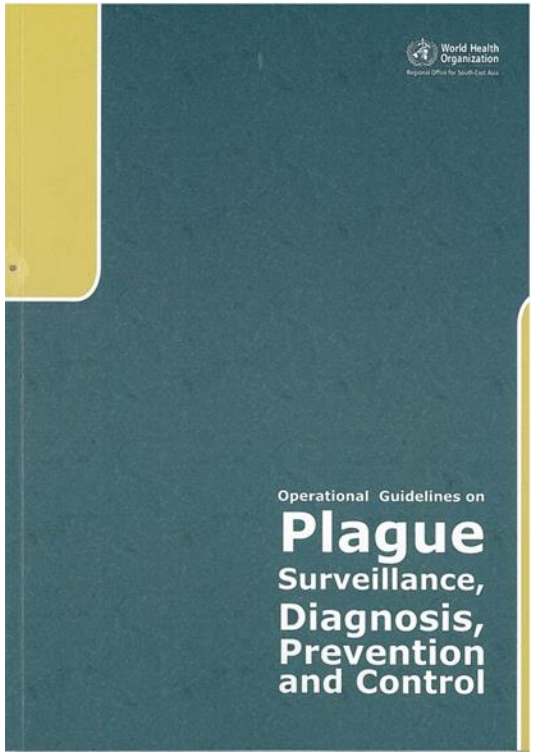
Areas* with potential plague natural foci based on historical data and current information

Notification of plague to WHO, 1969-2013



Reported plague outbreaks in Asia

- **China:** Reported from time to time **(**Regular/endemic)
- **India**: Pneumonic plague outbreak in Himachal Pradesh in Feb 2002 and bubonic plague in Uttarkashi in Oct 2004 (Reemerging)
- **Indonesia**: Pasuruan district of East Java in Feb 2007 (Reemerging)
- **Mongolia**: Reported from time to time (Regular/Endemic)
- **Myanmar**: 1994
- **Nepal**: 1968
- **Vietnam**: 2002



Epidemiological characteristics

Réservoirs

- Wild small mammals (gerbils and marmots)
- Marmots are the only creatures besides humans who can pass pneumonic plague from one to another under normal circumstances

Human behaviour, cultural practices

- Herders, hunters.. usually in handling and/or skinning dead animals (bitten by fleas or direct contact with the animal blood Bubonic plague+++
- Mortality due to plague remains very high because most outbreaks occur in remote places

Surveillance and response capacity

- ✓ Absence of any animal surveillance in most of the endemic countries
- ✓ Epidemiological silence

Natural disaster and war – Spillover effect

Climate change and microbial adaptation!

Plague in China

- The marmot is believed to have caused the 1911 pneumonic plague epidemic, which killed about 63,000 people in northeast China.
- Marmota plague foci are active in China, and the **epidemic boundary is constantly expanding**.
- The case-fatality rate for plague in humans was 68.88%; **the overall trend slowly decreased over time but fluctuated greatly**.
- Most human cases (98.31%) and isolates (82.06%) identified from any source were from the *Marmota himalayana* plague focus.

Distribution and Characteristics of Human Plague Cases and *Yersinia pestis* Isolates from 4 *Marmota* Plague Foci, China, 1950–2019

Zhaokai He,[1] Baiqing Wei,[1] Yujiang Zhang,[1] Jun Liu,[1] Jinxiao Xi,[1] Dunzhu Ciren,[1] Teng Qi,[1] Junrong Liang, Ran Duan, Shuai Qin, Dongyue Lv, Yuhuang Chen, Meng Xiao, Rong Fan, Zhizhong Song, Huaiqi Jing, Xin Wang

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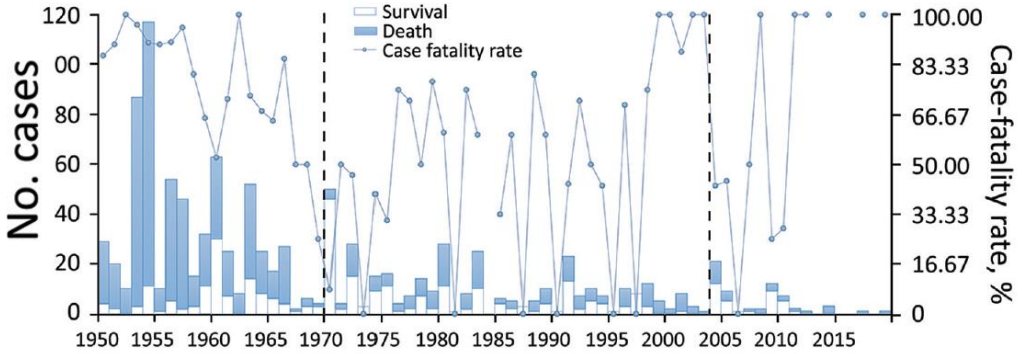


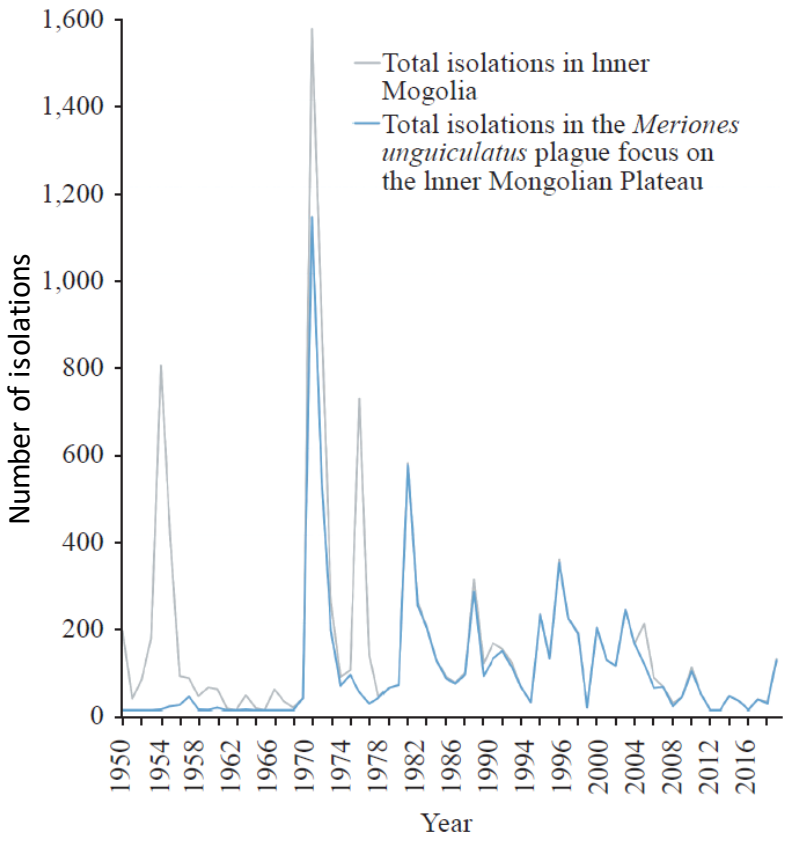
Xin Wang. B

Plague in China…

- From 1950 to 2019, a total of **267 plague cases in humans** were reported in the Inner Mongolia Autonomous Region with **133 deaths** and **10,710 Y. pestis isolates**.
- Four stages of transformation
  - Plague prevention and control (1950–1959)
  - **Plague eradication** (1960–1979)
  - Plague surveillance (1980–1999)
  - Comprehensive prevention and control stage under the emergency system (2000–2019)
- Bubonic plague is the main plague type of the *M. unguiculatus* plague focus.
- China's northern region of Inner Mongolia reported three cases of **bubonic plague in August 2023**

Epidemiological Characteristics of Plague in the *Meriones unguiculatus* Plague Focus — Inner Mongolia Autonomous Region, China, 1950–2019

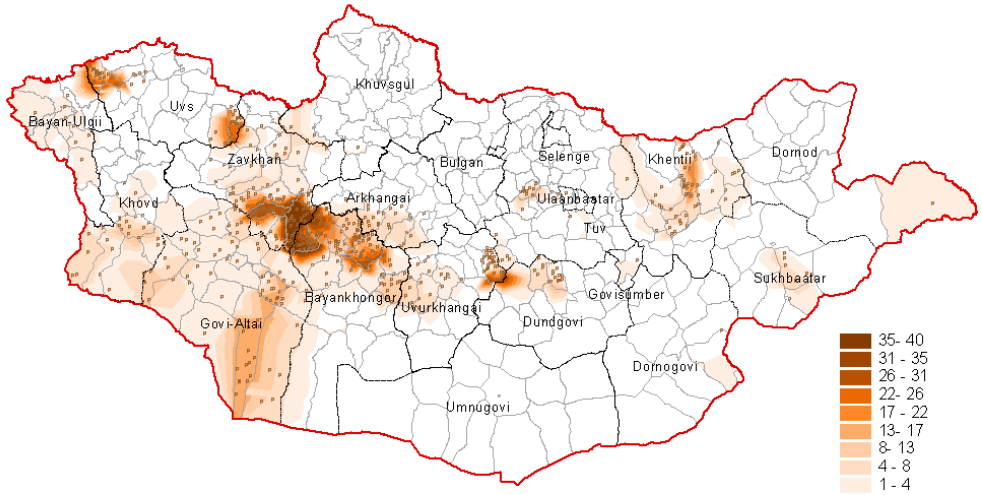
Boxi Liu[1]; Dayu Zhang[1]; Yuhuang Chen[2]; Zhaokai He[3]; Jun Liu[1]; Dongyue Lyu[3]; Weiwei Wu[3]; Ran Duan[3]; Shuai Qin[3]; Junrong Liang[3]; Huaiqi Jing[3]; Xin Wang[3,#]



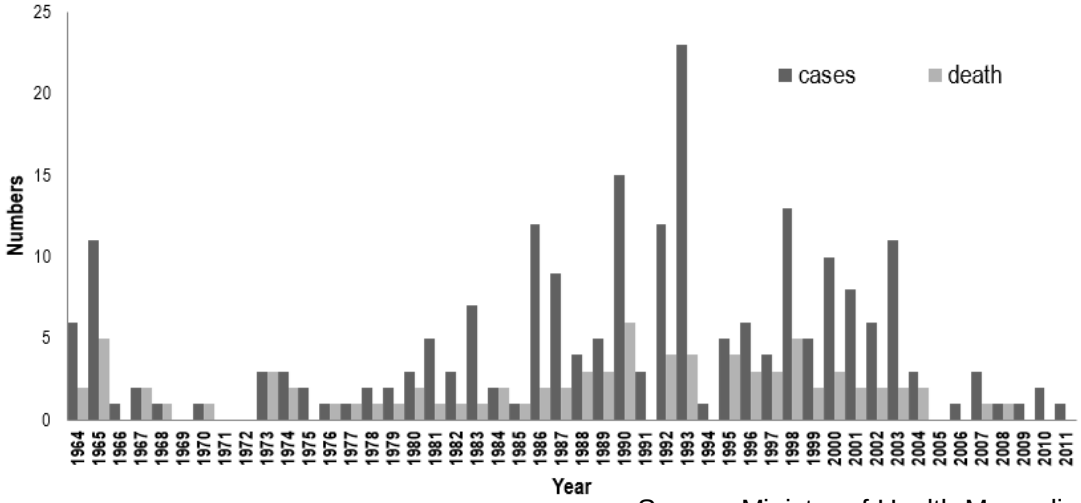
Plague in Mongolia

- Human plague peaked in the early 1990s and **gradually decreased** and currently only sporadic.
- High number of cases in men can be explained by the **hunting activity** of marmot.
- **Roast marmot** ("boodog" in Mongolian) is a **popular dish**, some unlucky hunters catch it every year
- **137 natural foci of plague** are found in 17 aimags (regions) of Mongolia, including on the border with Russia and China.
- Plague mostly occur in **Western and Steppe regions**.

Geographical distribution of Plague, Mongolia, 1928-2010



Plague cases registered in Mongolia, 1964-2011



Source: Ministry of Health Mongolia

Impact of climate change on marmot plague?

- A **density-dependent effect of precipitation** and a geographic location-dependent effect of temperature on marmot plague.
- A significantly positive relationship was evident between the **risk of plague and precipitation** only when the **marmot density** exceeded a certain threshold.

Climate-driven marmot-plague dynamics in Mongolia and China

Lei Xu[1], Qian Wang[1], Ruifu Yang[2], Dalantai Ganbold[3], Nyamdorj Tsogbadrakh[3], Kaixing Dong[1], Min Liu[4], Doniddemberel Altantogtokh[3], Qiyong Liu[5], Sainbileg Undrakhbold[6,7], Bazartseren Boldgiv[7]✉, Wannian Liang[1]✉ & Nils Chr. Stenseth[1,8,9]✉

Why can not we eradicate the plague?

- No human plague does not mean the absence of plague
- The **existence of animal reservoirs** that makes the plague hard to eradicate
- Unless we **exterminate animal reservoirs**, plague is always going to be around
- The Chinese experience clearly demonstrates that the **eradication of plague is not an achievable target**

Plague vaccine development in India

The third pandemic: The **first plague case was discovered in September 1896** at a grain merchant's quarters at Bombay's docks.

The **plague mortality rate was nearly twice that of cholera**.

On 10 January **1897**, **Haffkine injected himself** with 10cc of his preparation - a significantly higher dose than the 3cc he planned to use in wider testing. He experienced a severe fever but recovered after several days.

Haffkine went there to carry out **controlled tests**. He inoculated 147 prisoners and left 172 untreated. Just two cases and **no deaths among the treated**

Between 1897 and 1925, 26 million doses of Haffkine's anti-plague vaccine were sent out from Bombay.

Tests of the **vaccine's efficacy** showed between a **50% and 85%** reduction in mortality.