

Outbreak Reports

Epidemiological Investigation and Source Tracing of an Inhalation Anthrax Case with Traceability to Yunnan Province — Guangdong Province, China, March 2026

Jinhui Zhang^{1,&}; Shuang Wu^{2,&}; Chunyuan Deng^{3,&}; Enmin Zhang¹; Binbin Yu^{4,5}; Ao Luo⁶; Changyun Sun⁶; Huijuan Zhang¹; Canjun Zheng⁷; Haijian Zhou¹; Wei Li¹; Jianhua Lu²; Qiongcheng Chen²; Rong Fan⁸; Xuesen He⁹; Bili Ye¹⁰; Xiaolu Shi^{2,#}; Peng Wang^{4,5,#}; Jianchun Wei^{1,#}

Summary

What is already known about this topic?

Anthrax is a zoonotic disease caused by the bacterium *Bacillus anthracis* (*B. anthracis*). Inhalation anthrax, caused by inhalation of *B. anthracis* spores, is the rarest and most fatal form of anthrax. Historically, naturally acquired inhalation anthrax cases have mainly been associated with occupational exposure to infected animals or animal products, such as in wool mills or tanneries.

What is added by this report?

This report documents the first case of inhalation anthrax in China that was linked to environmental exposure in a historically endemic area, without direct contact with sick animals or animal products. The case was reported in Guangdong Province, however, the source was traced to the patient's newly built residence in Zhenxiong County, Yunnan Province, where environmental samples tested positive for *B. anthracis* nucleic acid. Three anthrax outbreaks have occurred in this region since 1990.

What are the implications for public health practice?

In anthrax-endemic areas, environmental exposure to contaminated soil or dust can pose a significant risk of anthrax infection, even without direct animal contact. Although rare, inhalation anthrax can occur naturally as *B. anthracis* spores can survive extreme environmental conditions in the soil or hay for long periods. As it is difficult to distinguish acute pulmonary infection from inhalational anthrax, severe cases were frequently initially suggested by metagenomic sequencing of the alveolar fluid, with similar findings reported for meningial anthrax in the cerebrospinal fluid.

ABSTRACT

Introduction: Inhalation anthrax, a zoonotic disease caused by *Bacillus anthracis* (*B. anthracis*) with high fatality rate, was reported on March 13, 2026, in Shenzhen City, Guangdong Province.

Methods: Epidemiological investigation was conducted using case interviews, close contact tracing, and environmental sampling. Clinical specimens were tested using targeted next-generation sequencing (tNGS), real-time polymerase chain reaction (real-time PCR), and serological methods. Source tracing, using environmental sampling and genomic sequence analysis, was performed in Zhenxiong County, Yunnan Province, where the patient resided before illness onset.

Results: A 47-year-old female factory worker presented with cough, fever, and progressive dyspnea. Laboratory testing detected *B. anthracis* nucleic acids in sputum and pleural effusion samples. Before illness onset, the patient had lived for 16 days in Zhenxiong County, a historical anthrax endemic area where three outbreaks had occurred. All environmental samples from Shenzhen tested negative; however, two environmental samples from the patient's newly built residence in Yunnan tested positive for *B. anthracis* nucleic acids; one *B. anthracis* strain was isolated. Core single nucleotide polymorphism (SNP) analysis showed that rough genomic sequences from the clinical sample and whole-genome sequence of environmental *B. anthracis* isolate fell into the same phylogenetic branch, with genetic distance of only 12 SNPs.

Conclusion: This is the first inhalation anthrax case to be acquired through environmental exposure without direct contact with animal products. The patient was diagnosed and managed successfully in Shenzhen. Source tracing identified the patient's home in Zhenxiong County, as the infection source.

Anthrax is a zoonotic disease caused by Gram-positive spore-forming bacterium *B. anthracis*. Its spores can survive in soil for decades and primarily infect herbivores. Human infections typically occur via contact with infected animals or contaminated animal products (1). There are three primary forms of this disease in humans: cutaneous, inhalation and gastrointestinal. The most common form of cutaneous anthrax accounts for 95% of cases worldwide (2). Inhalation anthrax is the rarest and the most fatal form. To date, anthrax remains an endemic disease, and approximately 300–500 cases are reported annually in China, especially in the northern and western provincial level administrative divisions (3). According to reports from the Infectious Disease Information Management System of the Chinese Center for Disease Control and Prevention (China CDC), most anthrax cases in China are cutaneous. Inhalation anthrax is extremely rare, and only six confirmed cases of pulmonary anthrax have been reported nationwide since 2005. According to China's Law on the Prevention and Treatment of Infectious Diseases, anthrax is classified as a Class B infectious disease; however pulmonary anthrax is managed in accordance with the regulations for Class A infectious diseases.

INVESTIGATION AND RESULTS

Case Description

A 47-year-old female factory worker living in Shenzhen, Guangdong Province, China, developed chills, productive cough, intermittent fever (maximum 38 °C), night sweats, and myalgia on March 1, 2026. She visited a private clinic twice, on March 2 and 5, with no improvement, and was then admitted at the Longgang Central Hospital of Shenzhen on March 8.

On admission, chest computed tomography (CT) revealed bilateral pneumonia with multiple consolidations, predominantly in the right lung, and bilateral pleural effusion. Sputum and pleural effusion samples were sent for targeted next-generation sequencing (tNGS) on March 10, which indicated *B. anthracis* infection. Follow-up CT on March 11 showed progression of pulmonary consolidation, but pulmonary angiography ruled out embolism. The patient received empiric antibiotics (ceftazidime and piperacillin-tazobactam), which were later escalated to meropenem plus doxycycline, and gradually stabilized.

Epidemiological Investigation

Before illness onset, the patient lived in a village in Zhenxiong County, Yunnan Province, from February 12 to 27, 2026, engaging in outdoor activities, including tomb commemoration and vegetable plot tilling. She denied direct contact with sick/dead animals, consumption of meat from an unknown source, or occupational exposure to animal hide or wool. She mainly consumed beef purchased from local villagers or markets.

A thorough dermatological examination revealed herpes on her lips and blisters on her hands, but no lesions consistent with cutaneous anthrax (no eschar or black crust). Polymerase chain reaction (PCR) testing of the blister fluid and herpes swab samples was negative for *B. anthracis*, ruling out the presence of primary cutaneous anthrax with pulmonary dissemination.

Regarding local animal deaths, three households reported abnormal pig deaths in the six months preceding the infection; owners did not skin or consume dead pigs. Three puppies died of diarrhea in January 2026. However, no carcasses were available for testing as they had been buried or discarded. Burial sites and their distances from the patients' residence could not be determined.

To further exclude gastrointestinal or cutaneous routes, the patient was queried during multiple interviews regarding the about consumption of raw/undercooked meat, handling of animal products, skin wounds during farming, and use of the rag found in her new home that tested positive. She reported that rags were used for general dusting and not for handling raw meat. She consistently denied all the above exposures. Therefore, inhalation of aerosolized spores during outdoor activities or within her contaminated new home was deemed the most plausible route.

Laboratory Confirmation

Sputum and pleural effusion samples from the patient tested positive for *B. anthracis* using tNGS. These samples also tested positive using real-time PCR (*pagA*, *capC*, and *rpoB*; Ct values 31/31/33) (4). Blood samples tested positive for antibodies against anthrax in the colloidal gold assay. According to the national diagnostic standard (WS 283–2020), positive nucleic acid detection combined with positive serology fulfills the criteria for laboratory confirmation, despite the failure to isolate a live strain. The inability to obtain a bacterial isolate was most likely due to empirical

antibiotic administration prior to specimen collection. Because no *B. anthracis* strain was isolated from the patient samples, DNA from the patient's pleural effusion was sequenced using a probe hybridization capture method, and the rough genome of *B. anthracis* was obtained.

To investigate the source of infection, environmental samples were collected from the patient's workplace and residence in Shenzhen and from her residence in Zhenxiong. Ninety-three environmental samples collected in Shenzhen were negative. In Zhenxiong, 44 environmental samples were collected in two rounds of sampling; two samples (dust from a rag at the bedroom door of the patient's newly built residence and a swab from the stair step) tested positive for *B. anthracis* nucleic acid (Ct values of the two samples were 21 and 23, respectively) (Table 1). The whole genome of one *B. anthracis* strain isolated from the rag at the bedroom door was sequenced.

Two molecular approaches, canonical single nucleotide polymorphisms (canSNP) and whole-genome SNP analyses were used to identify the phylogenetic relationships among *B. anthracis* isolates. The rough genome of *B. anthracis* (GDSZ2026) from the patient and the whole-genome (YNZX2026) of environmental *B. anthracis* isolates were all identified as the canSNP A.Br.001/002 subgroup. The A.Br.001/002 subgroup is the dominant subgroup in China and is scattered throughout mainland China (3).

Core-SNP analysis of the two sequences (GDSZ2026 and YNZX2026) with 659 *B. anthracis* strains from China CDC database was performed using GATK4 (reference: *B. anthracis* Ames Ancestor), Snippy for cgSNP extraction, and IQ-TREE (GTR model). The 29 co-clustering strains (all A.Br.001/002) were further analyzed, and the phylogeny placed the two sequences on the same branch,

indicating a close genetic relationship and clear divergence from other geographic strains (Figure 1).

PUBLIC HEALTH RESPONSE

Upon receiving a confirmed anthrax case, the China CDC and local CDC teams, undertook epidemiologic and clinical investigations and initiated outbreak control measures. Shenzhen CDC immediately initiated outbreak control measures, placed all close contacts under medical observation, and implemented infection control measures. The Yunnan CDC promptly conducted source tracing and investigation, including the investigation of local animal husbandry and screening of suspected cases. Following the Technical Guidelines for the Prevention and Control of Anthrax (2021 edition), close contact tracing was conducted in Shenzhen City and Zhenxiong County, which identified 43 and 18 contacts, respectively. After 14 days of surveillance, no cases of exposure to the same source were identified, and the outbreak was effectively contained.

DISCUSSION

Naturally acquired inhalation anthrax is the rarest and most fatal form of anthrax (5). *B. anthracis* spores can survive in soil and contaminated animal products for decades (6). The source of the patient's infection was traced to a newly built house in Zhenxiong County, Yunnan Province, where environmental samples tested positive for *B. anthracis*. The investigation indicated that the patient had been exposed to airborne dust once in living areas. Zhenxiong County is considered an anthrax enzootic area, where three historical anthrax outbreaks (1990,

TABLE 1. Environmental sampling results in Shenzhen and Zhenxiong County, Yunnan Province, China, March 2026.

City or county	Sampling location	Total number of samples	Number of nucleic acid-positive samples	Number of nucleic acid-negative samples
Shenzhen	Patient's home	17	0	17
Shenzhen	Workplace (electronics factory)	20	0	20
Shenzhen	Clinics and hospitals	31	0	31
Shenzhen	Home of close contact relatives	25	0	25
Zhenxiong County	Patient's new home	12	2	10
Zhenxiong County	Soil around old home	13	0	13
Zhenxiong County	Slaughter stalls	16	0	16
Zhenxiong County	Dead pig pen	1	0	1
Zhenxiong County	Dog pen; residual sick pig meat	2	0	2

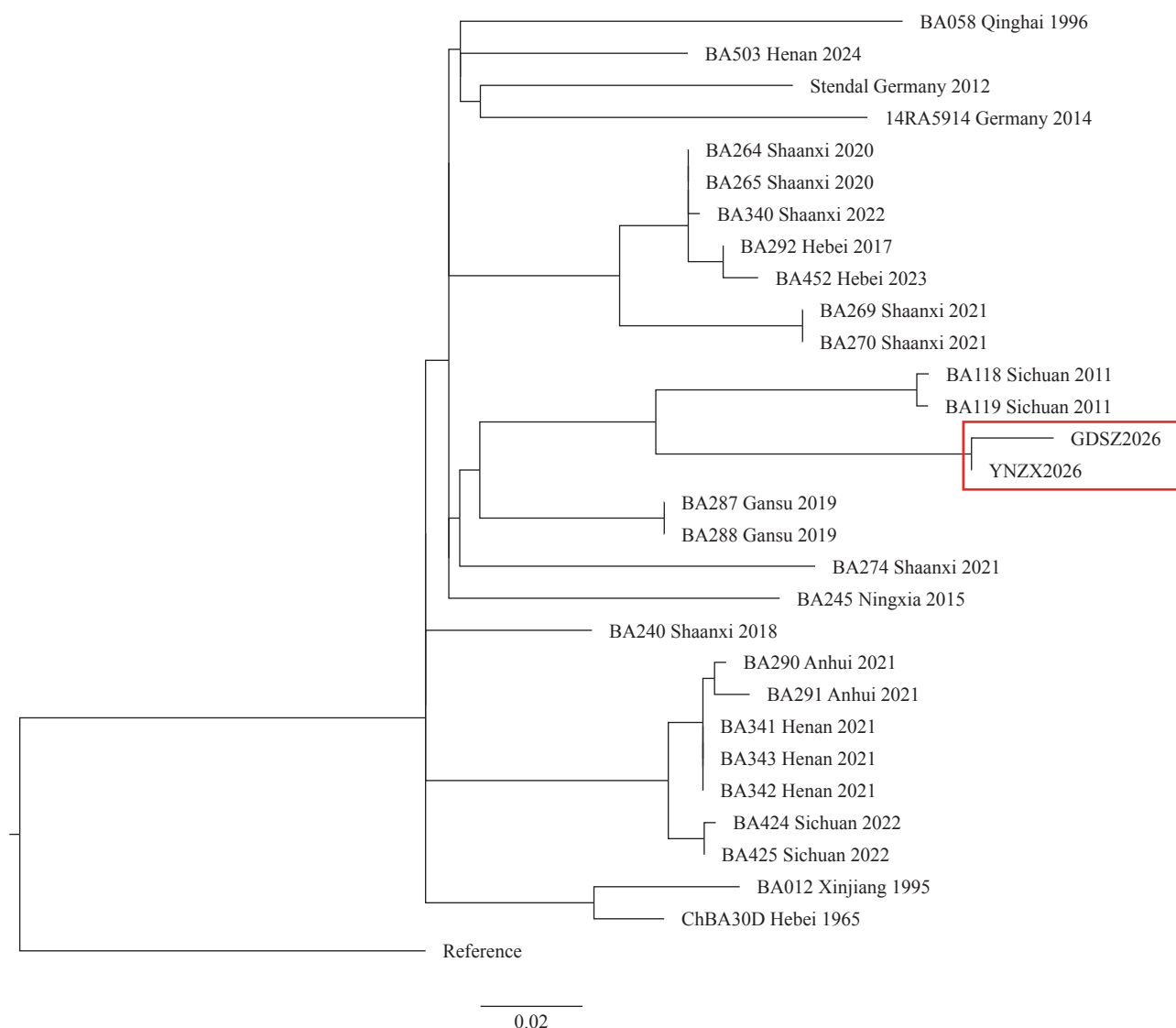


FIGURE 1. Phylogenetic tree of 29 *B. anthracis* strains based on 448 SNPs.

Note: Red box indicates GDSZ2026 and YNZX2026.

Abbreviation: SNP=single nucleotide polymorphism.

2001, and 2014) have been reported, indicating persistent environmental contamination. Unlike most anthrax cases, this patient had no direct contact with sick animals, suggesting that environmental exposure alone can pose a risk of infection in historically endemic areas. This finding is consistent with reports from Iran and the United States (7–8).

Although inhalation anthrax typically follows a fulminant course (5), this case presented with a relatively indolent 7-day course. This may be explained by a lower initial spore inoculum, a partial host immune response, and early administration of empirical broad-spectrum antibiotics, which may have suppressed secondary infections. This case illustrates that naturally acquired inhalation anthrax can present

subacutely, and clinicians should maintain suspicion even in the absence of rapid progression.

Samples collected from patients after antibiotic treatment, whether skin anthrax swabs or pleural effusion samples from inhalation anthrax, often exhibit low bacterial DNA concentrations and severe fragmentation, resulting in poor sample quality. This was reflected in the PCR testing by frequently observed Ct values of >30. Metagenomic sequencing of such samples may introduce errors that affect SNP and other variant analyses. Nevertheless, here, the patient-infecting and environmentally isolated strains clustered on the same phylogenetic tree branch, indirectly supporting the validity of direct infection.

We propose four actionable recommendations:

enhanced environmental surveillance and animal death reporting in endemic areas, primary healthcare training and wider access to rapid diagnostics, empirical anthrax coverage for refractory pneumonia, and a national cross-regional tracing framework with standardized protocols and a shared genomic database.

We could not obtain local *B. anthracis* sequence data from Zhenxiong County, Yunnan Province, and therefore could not further analyze the differences between the patient samples, residential isolated strain, and local strains. Future isolation of *B. anthracis* strains from additional sites may provide more compelling evidence of this outbreak. Owing to limitations in environmental sampling, the reliable outbreak-related positive findings were merely the PCR detection of two rags within the residence and the isolation of one *B. anthracis* strain. Environmental samples from outside the patient's residence were all negative. Post-mortem samples from deceased pigs and dogs could not be collected, leaving gaps in the chain of evidence. Therefore, continuous environmental monitoring is required to obtain direct evidence.

Conflicts of interest: No conflicts of interest.

Acknowledgements: Supported by the National Key Research and Development Program of China (2023YFC2605601), Guangzhou National Laboratory Project (GZNL2024A01025), and Yunnan Medical Leading Talent Training Project (L-2019001).

doi: 10.46234/ccdcw2026.169

* Corresponding authors: Jianchun Wei, weijianchun@icdc.cn; Peng Wang, wp030801@126.com; Xiaolu Shi, shixl@wjw.sz.gov.cn.

¹ National Key Laboratory of Intelligent Tracking and Forecasting for Infectious Diseases, National Institute for Communicable Disease Control and Prevention, Chinese Center for Disease Control and Prevention & Chinese Academy of Preventive Medicine, Beijing, China; ² Shenzhen Center for Disease Control and Prevention, Shenzhen City, Guangdong Province, China; ³ Zhenxiong County Center for Disease Control and Prevention, Zhaotong City, Yunnan Province, China; ⁴ Yunnan Institute for Endemic Disease Control and Prevention, Dali City, Yunnan Province, China; ⁵ Yunnan Provincial Key Laboratory for Zoonosis Control and Prevention, Dali City,

Yunnan Province, China; ⁶ Guangdong Provincial Center for Disease Control and Prevention, Guangzhou City, Guangdong Province, China; ⁷ Division of Infectious Disease, Chinese Center for Disease Control and Prevention & Chinese Academy of Preventive Medicine, Beijing, China; ⁸ Zhaotong City Center for Disease Control and Prevention, Zhaotong City, Yunnan Province, Yunnan, China; ⁹ Longgang Central Hospital of Shenzhen, Shenzhen City, Guangdong Province, China; ¹⁰ Longgang District Center for Disease Control and Prevention, Shenzhen City, Guangdong Province, China.

& Joint first authors.

Copyright © 2026 by Chinese Center for Disease Control and Prevention & Chinese Academy of Preventive Medicine. All content is distributed under a Creative Commons Attribution Non Commercial License 4.0 (CC BY-NC).

Submitted: June 11, 2026

Accepted: August 06, 2026

Issued: August 14, 2026

REFERENCES

1. World Health Organization. Anthrax in humans and animals. 4th ed. Geneva: WHO Press. 2008. <https://www.who.int/publications/i/item/9789241547536>.
2. Yu DS, He J, Zhang EM, Wang P, Liu DP, Hou YD, et al. Investigation and source-tracing of an anthrax outbreak in Gansu Province, China. *PLoS One* 2018;13(8):e0203267. <https://doi.org/10.1371/journal.pone.0203267>.
3. Zhang HJ, Zhang EM, He JR, Li W, Wei JC. Genetic characteristics of *Bacillus anthracis* isolated from northwestern China from 1990 to 2016. *PLoS Negl Trop Dis* 2018;12(11):e0006908. <https://doi.org/10.1371/journal.pntd.0006908>.
4. Liu DL, Wei JC, Chen QL, Guo XJ, Zhang EM, He L, et al. Genetic source tracking of an anthrax outbreak in Shaanxi Province, China. *Infect Dis Poverty* 2017;6(1):14. <https://doi.org/10.1186/s40249-016-0218-6>.
5. Holty JEC, Bravata DM, Liu H, Olshen RA, McDonald KM, Owens DK. Systematic review: a century of inhalational anthrax cases from 1900 to 2005. *Ann Intern Med* 2006;144(4):270 – 80. <https://doi.org/10.7326/0003-4819-144-4-200602210-00009>.
6. Tompkins LS. *Bacillus anthracis*. In: Mandell GL, Bennett JE, Dolin R, editors. *Mandell, Douglas, and Bennett's principles and practice of infectious diseases*. 8th ed. Philadelphia: Elsevier-Churchill Livingstone. 2015; p. 2702-11.
7. Azarkar Z, Zare Bidaki M. A case report of inhalation anthrax acquired naturally. *BMC Res Notes* 2016;9:141. <https://doi.org/10.1186/s13104-016-1955-0>.
8. Griffith J, Blaney D, Shadomy S, Lehman M, Pesik N, Tostenson S, et al. Investigation of inhalation anthrax case, United States. *Emerg Infect Dis* 2014;20(2):280 – 3. <https://doi.org/10.3201/eid2002.130021>.