

Outbreak Reports

Investigation and Response to the First Case of Inhalational Anthrax Caused by Inhaling Wind-Blown Dust Containing *Bacillus anthracis* Spores — Kaifeng City, Henan Province, China, 2026

Changhong Huang^{1,✉}; Huijuan Zhang^{2,✉}; Mengying Xiao¹; Lei Chen¹; Qihui Shao¹; Jinhua Su¹; Mengchen Li¹; Shihong Zhang¹; Huitao Sun¹; Jiyan Liu¹; Shuhua Huang¹; Kun Wang¹; Jinhui Zhang²; Yue Shi³; Fang Zhao¹; Shuai Ding^{1,✉}; Jianchun Wei^{2,✉}

Summary

What is already known about this topic?

Inhaling *Bacillus anthracis* spore-laden dust or aerosols can cause inhalational anthrax; such direct-inhalation infection is uncommon and usually affects people who handle diseased animals or animal products.

What is added by this report?

On May 2, 2026, a Beijing hospital reported confirmed inhalational anthrax in a Kaifeng resident. Exposure to a previously contaminated environment was the probable route of infection, and targeted next-generation sequencing (tNGS) was key to the diagnosis.

What are the implications for public health practice?

This report offers a reference for investigating and managing inhalational anthrax in patients without a clear occupational or exposure history; for conditions that resist rapid diagnosis, tNGS may aid preliminary diagnosis.

reaction for *B. anthracis* nucleic acids, and rapid antigen and antibody testing.

Results: The probable source was *B. anthracis* introduced when the patient's brother handled a diseased cow in 2023; he had suspected cutaneous anthrax, and the family's sheep subsequently died. Spores persisted in the contaminated area, and 3 years later, the patient became infected by inhaling spore-containing aerosols.

Conclusion: This case represents non-occupational inhalational anthrax caused by exposure to an environment previously contaminated with *B. anthracis*, with tNGS playing a key role in diagnosis. The epidemiological investigation, specimen collection, clinical presentation, and terminal disinfection can serve as a reference for public health responses to anthrax outbreaks.

ABSTRACT

Introduction: Inhalational anthrax is caused by *Bacillus anthracis* (*B. anthracis*) and typically acquired by inhaling aerosols from infected animals or animal products. Compared with cutaneous anthrax, it is rare and has a high case-fatality rate, and few cases have been reported in China. On May 2, 2026, a Beijing hospital reported confirmed inhalational anthrax in a resident of Kaifeng City, Henan Province, and Kaifeng CDC immediately launched a field investigation and emergency response.

Methods: A field epidemiological investigation collected relevant data. Human and environmental specimens underwent targeted next-generation sequencing (tNGS), real-time polymerase chain

Inhalational anthrax is an infectious disease caused by *Bacillus anthracis* (*B. anthracis*), typically acquired through inhalation of aerosols generated from infected animals or animal products. Compared with cutaneous anthrax, inhalational anthrax is rare and has a high case-fatality rate; very few cases have been reported in China. On May 2, 2026, a hospital in Beijing reported a confirmed case of inhalational anthrax in a resident of Kaifeng City, Henan Province. Upon receiving the notification, Kaifeng City immediately activated a joint prevention and control mechanism and, together with experts from the National and Provincial CDCs, conducted a field epidemiological investigation and response.

INVESTIGATION AND RESULTS

The patient was a 36-year-old Han Chinese woman,

a university teacher in Henan Province, with no notable medical history. On April 24, 2026, she developed a low-grade fever. On April 25–26, her temperature rose to 39 °C, accompanied by chills, a predominantly dry cough, and shortness of breath; self-medication brought no improvement. On April 27, her symptoms worsened — dizziness, profuse sweating, chest tightness, dyspnea, and hypotension — and she was taken by ambulance to a Kaifeng hospital. Laboratory tests showed a white blood cell count of $12.24 \times 10^9/\text{L}$ and a neutrophil percentage of 80.7%. Chest computed tomography (CT) indicated right-lung pneumonia, a suspected mass, bilateral pleural effusion (right-predominant), a small pericardial effusion, and multiple enlarged mediastinal lymph nodes, consistent with previously reported cases (1–2). Repeated closed drainage of the right pleural cavity yielded approximately 3,350 mL of bloody pleural fluid. Cultures of pleural fluid and sputum grew no pathogens, and tests for respiratory syncytial virus, influenza virus, and adenovirus were negative. On April 30, the patient traveled alone by high-speed rail to a Beijing hospital, which collected pleural fluid, peripheral blood, and bronchoalveolar lavage fluid for third-party targeted next-generation sequencing (tNGS). On May 2, *B. anthracis* sequences were detected in pleural fluid and peripheral blood. The same day, Beijing CDC confirmed both by real-time polymerase chain reaction (PCR): pleural fluid was positive for all three target genes (*pagA*, *cap*, *rpoB*) and peripheral blood for *pagA* and *cap*. The patient's serum was also positive for anthrax-specific antibodies and the pleural fluid for anthrax antigen. The patient was diagnosed with inhalational anthrax according to *Diagnosis for anthrax* (WS283-2020). From April 27 she received sequential anti-infective therapy (ceftizoxime; moxifloxacin plus cefoperazone-sulbactam; then meropenem/moxifloxacin/linezolid).

The patient had not performed laboratory work or contacted laboratory animals; the household kept only one cat and had not recently bought fur products or received cross-border parcels. Between April 10 and 24 she had not processed or eaten raw beef or mutton and had no exposure to livestock farming, fur processing, or other high-risk settings, and she had no skin lesions or gastrointestinal symptoms. She visited her parents' home in a rural village on the outskirts of Kaifeng every 2 to 3 days.

The patient's parents lived with her elder brother and his family. In early August 2023, the brother

bought a sick cow from a local dairy farmer whose cattle originated from a farm in Xiangfu District, Kaifeng — a district that has reported sporadic anthrax cases each year from 2023 to 2025. The brother reportedly butchered the cow at his front door and washed the beef in the courtyard while nursing an open wound on his arm. On August 9, the injured arm developed furuncles and oozing skin lesions, symptoms suggestive of cutaneous anthrax. He was hospitalized on August 14 without a definitive diagnosis. One month later, the family's two sheep died one after another from unknown causes; the remaining live sheep were all sold, and no livestock has been kept since.

On May 3, 90 surface swabs from the patient's and her parents' homes were all negative by real-time PCR. On May 4, using a larger sample volume and an improved extraction method, 1 of 11 surface samples from the parents' home — near the sheep pen — was positive. On May 5, guided by the epidemiological findings, 6 of 9 additional soil samples from the beef-washing site and sheep pen were positive. All positive samples were dust collected from paved surfaces (full details can be found in Figure 1). Serum samples were collected from nine family members and relatives with a shared exposure history, and three tested positive for anthrax-specific antibodies. Detailed sampling information and test results are presented in Table 1.

Taken together — the clinical presentation, pleural-fluid tNGS, confirmatory *B. anthracis*-specific PCR, the brother's suspected cutaneous anthrax, the abnormal animal deaths, and the environmental results — the team concluded this was a rare case of non-occupational inhalational anthrax. The source of infection was *B. anthracis*, introduced when the brother handled the diseased cow in 2023, which led to suspected cutaneous anthrax and contaminated the indoor and outdoor environments. The family's sheep became infected and died, and the shed bacteria further contaminated the household soil, where *B. anthracis* persisted as long-lived spores. Against a background of abundant surface dust and strong, dust-raising spring winds, the patient was likely infected by directly inhaling aerosols containing *B. anthracis* spores. In addition, serological testing of family members showed that despite the absence of obvious clinical symptoms, three individuals tested positive for anthrax antibodies. This subclinical infection pattern further indicates the long-standing risk of environmental exposure in the area.

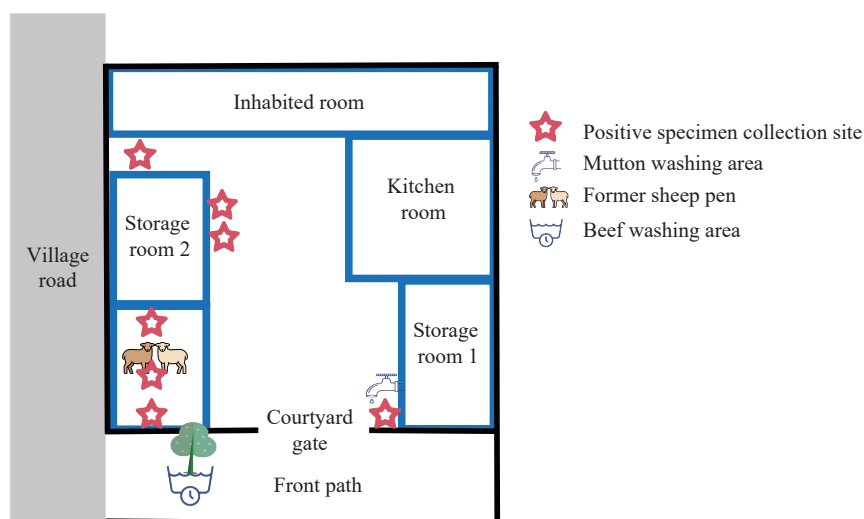


FIGURE 1. Schematic layout of the patient's parental household and positive environmental sampling sites, Kaifeng City.

TABLE 1. Laboratory results of specimens collected for epidemiological traceback of inhalational anthrax, Kaifeng City, 2026.

Specimen category	Total number of samples	Number of antibody-positive samples	Number of nucleic acid-positive samples	Number of culture-positive samples
Serum samples from household close contacts	9	3	0	N/A
Throat swabs from household close contacts	8	N/A	0	N/A
Environmental swab specimens collected at the patient's parents' residence	14	N/A	0	0
Soil specimens collected at the patient's parents' residence	20	N/A	7	0
Other relevant environmental specimens	113	N/A	0	N/A
Patient's residence	12	N/A	0	N/A
Workplace	35	N/A	0	N/A
Dining venues	3	N/A	0	N/A
Hospital for medical treatment	5	N/A	0	N/A
Vehicles used by the patient to travel to the parents' home	4	N/A	0	N/A
Neighboring livestock farm next to the patient's parents' house	5	N/A	0	N/A
Shops selling beef and mutton products visited by the patient	35	N/A	0	N/A
Zoo visited by the patient	3	N/A	0	N/A
Premises where the patient's brother slaughtered cattle	11	N/A	0	N/A

Note: "N/A" means the test was not performed.

PUBLIC HEALTH RESPONSE

This inhalational anthrax outbreak was classified as a Level III public health emergency. The patient was transferred to a designated infectious disease hospital in Beijing and treated in a single room.

Per the *Technical Guidelines for Anthrax Prevention and Control* (2021 edition) (3), 82 close contacts were

identified (17 family members, plus healthcare workers, colleagues, and students). The nine family members with shared environmental exposure underwent 14 days of centralized quarantine with medical observation and prophylaxis; the rest were quarantined at home under observation. No new cases occurred among the close contacts.

Medical institutions conducted emergency anthrax

training. All urban-area institutions searched for suspected cases back to April, and 14 days of emergency surveillance (May 1–14) identified none.

Terminal disinfection was performed in potentially contaminated areas, including the patient's and her parents' homes. At the parents' home, all exposed bare-soil surfaces inside the house and courtyard were then sealed with a 12-cm cement layer; disinfection was evaluated as effective.

The outbreak was reported to the agricultural authorities, who investigated livestock illnesses and deaths and found no abnormalities. Health education was provided jointly with the Bureau of Agriculture and Rural Affairs.

DISCUSSION

This outbreak was a sporadic event in which a patient acquired inhalational anthrax through the inhalation of dust from soil previously contaminated with *B. anthracis* spores. Although Kaifeng is not a pastoral region, it has become a natural focus of anthrax. In 2023, anthrax reemerged in Kaifeng after a 38-year interval since the last historical outbreak. From 2023 to 2025, 13 locally acquired anthrax cases occurred — 4 in Weishi County, 8 in Xiangfu District, and 1 in Lankao County. Apart from one cutaneous anthrax cluster involving three cases, all cases were sporadic.

Anthrax transmission chains are complex and hard to trace. In earlier Kaifeng cases the source could not be determined, leaving contaminated environments undetected and undisinfected — a hidden hazard that can readily create persistent natural foci (4). In this outbreak, the environment contaminated by the diseased cow and sheep 3 years prior was not properly disinfected, which most likely led to this case of inhalational anthrax.

Naturally acquired inhalational anthrax in humans often results from contact with animals or animal products (5), while soil-borne transmission to humans is extremely rare (6). Cases from the United States and Iran (7–8) have shown that inhalational anthrax in non-occupational populations is often incidental, with diverse and covert routes of infection. The three inhalational anthrax cases reported in China between 2021 and 2025 were all associated with recent contact with diseased animals or animal products (9–11). The present case, however, is relatively rare in that it occurred without recent animal exposure but rather

resulted from long-term residual soil contamination. This outbreak underscores that source tracing should consider not only occupational history and recent animal or animal product contact within the incubation period, but also the prior status of the exposure environment, since the true source may have dated back months or years. Epidemiological information enables precise targeting of specimen collection — repeated sampling of contaminated environments, larger sample volumes, and improved nucleic acid extraction — which can substantially increase detection rates. Specimen collection and processing methods can affect results and warrant attention in future studies.

Medical institutions have limited capacity to diagnose rare infections such as inhalational anthrax, prompting long-distance referral. Strengthening training and case-based discussion can enhance clinicians' diagnostic awareness, and tNGS can improve diagnostic efficiency for pneumonia of unknown cause. Although the patient was not diagnosed early by the hospital, prompt empirical antibiotic treatment was crucial to manage the disease and reduce its duration. The three cases reported in China in recent years recovered well with early antibiotic treatment (9–11).

Informal household farmers often slaughter, sell, and eat cattle and sheep without official oversight, which is a major risk factor for disease transmission (11). This case emphasizes the importance of appropriate carcass disposal and management of previously contaminated environments. To reduce the risk of transmission and long-term environmental contamination, it is necessary to strengthen animal disease surveillance and sustained environmental monitoring of historical anthrax foci and to implement multi-sectoral prevention and control measures. These should include vaccinating livestock in high-risk areas, improving biosafe carcass disposal and quarantine procedures, and reinforcing joint supervision of informal livestock slaughter to keep diseased animals and their products out of the market. In addition, intensive health education on anthrax prevention and control should be directed toward key industries, at-risk populations, and high-risk areas to enhance public awareness and response capacity.

This study has some limitations. Cultures of the patient's samples and the positive environmental samples from the parents' home did not yield *B. anthracis*, and no sequence-based homology analysis

was performed between the patient and environmental samples; therefore, direct molecular evidence linking to the source is lacking. Because the cross-sectional survey was conducted within a confined time window, this investigation was unable to capture the temporal dynamics of environmental contamination or spore load.

To our knowledge, this is the first reported case of inhalational anthrax caused by non-occupational environmental exposure in Kaifeng City, Henan Province, together with an outbreak response providing experience for the prevention and control of anthrax, particularly inhalational anthrax.

Conflicts of interest: No conflicts of interest.

Acknowledgements: Ying Ye, Jingjing Pan, Yafei Li, Su Yan, Yuqin Zhang, Lijun Gao, Xue Luo, and Shidong Lu of the Henan Provincial Center for Disease Control and Prevention for their technical guidance throughout the epidemiological investigation, source tracing, specimen collection, laboratory testing, and disinfection.

Funding: Supported by the Kaifeng Municipal Science and Technology Development Program (Grant No. 2503091).

doi: [10.46234/ccdcw2026.170](https://doi.org/10.46234/ccdcw2026.170)

Corresponding authors: Shuai Ding, dsds1982@163.com; Jianchun Wei, weijianchun@icdc.cn.

¹ Kaifeng Center for Disease Control and Prevention, Kaifeng City, Henan Province, China; ² 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; ³ Division of Infectious Disease, Chinese Center for Disease Control and Prevention & Chinese Academy of Preventive Medicine, Beijing, 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 12, 2026

Accepted: August 05, 2026

Issued: August 14, 2026

REFERENCES

1. Wang RW, Li YH, Chen QG, Wang CC, Pan JJ, Ye Y, et al. Report of the first case of pulmonary anthrax in Henan province. *Chin J Infect Control* 2026;25(3):442 – 4. <https://doi.org/10.12138/j.issn.1671-9638.20262808>.
2. Lin CY, Dou XF, Zhang DT, Sun YQ, Han HQ, Chen CZ, et al. Epidemiological investigation of an inhalational anthrax patient traveling for medical treatment in Beijing Municipality, China, August 2021. *China CDC Wkly* 2022;4(1):4 – 7. <https://doi.org/10.46234/ccdcw2021.275>.
3. Chinese Center for Disease Control and Prevention. Technical guidelines for anthrax prevention and control (2021 Edition). 2021. https://www.chinacdc.cn/jkyj/crb2/yl/tj/jswj_tj/. [2021-11-25]. (In Chinese).
4. World Health Organization. Anthrax in humans and animals. 4th ed. Geneva: WHO. 2013. <https://www.who.int/publications/b/31250>.
5. Nguyen TQ, Clark N. Public health and environmental response to the first case of naturally acquired inhalational anthrax in the United States in 30 years: infection of a New York City resident who worked with dried animal hides. *J Public Health Manag Pract* 2010;16(3):189 – 200. <https://doi.org/10.1097/PHH.0b013e3181ca64f2>.
6. Finke EJ, Beyer W, Loderstädt U, Frickmann H. Review: the risk of contracting anthrax from spore-contaminated soil—a military medical perspective. *Eur J Microbiol Immunol* 2020;10(2):29 – 63. <https://doi.org/10.1556/1886.2020.00008>.
7. 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>.
8. Azarkar Z, Bidaki MZ. A case report of inhalation anthrax acquired naturally. *BMC Res Notes* 2016;9:141. <https://doi.org/10.1186/s13104-016-1955-0>.
9. Chen CZ, Liu F, Li S, Dou XF. Discussion and consideration of the control of imported pulmonary anthrax in Beijing. *Chin J Zoonoses* 2022;38(8):740 – 3. <https://doi.org/10.3969/j.issn.1002-2694.2022.00.100>.
10. Guo WB, Wang TT, Song ZK, Liu QY, Sun JJ. One case of occupational pulmonary anthrax. *Chin J Ind Hyg Occup Dis* 2025;43(9):705 – 7. <https://doi.org/10.3760/cma.j.cn121094-20240719-00326>.
11. Pan JJ, Li SW, Chen QL, Yan S, Li ZY, Li YF, et al. Investigation of a pulmonary anthrax case in Henan province, 2025. *Chin J Public Health* 2026;42(4):460 – 3. <https://doi.org/10.11847/zgggws1147582>.