CHINA MEDICAL BOARD
• 1914 •

October 28, 2024

Mr. WU Peixin
Chairman
Peking Union Medical College Education Foundation
9 Dong Dan San Tiao
Dongcheng District
Beijing 100730
P. R. China

Re: Grant Notification Letter: Grant #24-564

Dear Chairman Wu,

I am pleased to inform you that the China Medical Board (CMB) has approved a grant of US$100,000 to Peking Union Medical College Education Foundation ("you") for supporting a research project on artificial intelligence-assisted chest X-ray in TB screening. This grant is being made in response to the proposal "Artificial intelligence-assisted chest X-ray in TB screening: effectiveness of enhancing the care cascades in Chinese primary-care settings (ACCESS-CARE)" (the "Proposal") submitted by Dr. WANG Ye at School of Population Medicine and Public Health, China Academy of Medical Sciences & Peking Union Medical College.

The following terms apply to the grant:

a) Grant funds will be available for expenditure during a three-year period beginning on January 1, 2025.

b) Grant funds will be paid in lump sum. The payment will be made by CMB Beijing Representative Office in the form of Chinese Yuan (applying the currency exchange rate of the transaction time). The payment will be made upon receipt of the countersigned copy of this letter and your payment instructions. Please complete the payment instructions located in Attachment III.

c) Grant funds and any income therefrom shall be used only for the purposes outlined in this letter and as described in the proposal. All expenditures must adhere to the relevant accounting and grant management policies and regulations of your institution. Prior written approval from CMB is required for any extension of the grant duration. Grant funds must be maintained in a separate fund dedicated to the purposes stated in this letter and described in the proposal.

d) Within ninety [90] days after the close of the first year of the project and any subsequent year in which you have any unexpended grant funds remaining, you will provide CMB with a narrative and financial report, signed by an authorized officer, describing the manner in which grant funds were used, your compliance with the terms of this grant agreement, and the progress made in accomplishing the grant purpose. In addition, within

ninety [90] days after the completion of the project, you will submit a final narrative and financial report to CMB with respect to all expenditures under the grant and indicating your progress made toward accomplishing the grant purpose. Please refer to Attachment Il for specific reporting schedule. The reports should include a financial accounting of actual expenditures against the line items in the approved budget. Budget modification or time extensions of the grant terms may be requested at the time of annual reports.

e) Under United States law, CMB grant funds, and any income therefrom, may be expended only for charitable, scientific, literary, or educational purposes. You agree not to use the grant funds, or any income therefrom (i) for any purpose other than charitable purposes consistent with the provisions of Section 170(c)(2)(B) of the Internal Revenue Code of 1986, as amended (the "Code"); (ii) to carry on propaganda, or otherwise to attempt to influence legislation within the meaning of Section 4945(d)(1) of the Code; (iii) to influence the outcome of any specific public election, or to carry on, directly or indirectly, any voter registration drive within the meaning of Section 4945(d)(2) of the Code; or (iv) to make a grant to any individual for travel, study, or other similar purposes, or to make a grant to any organization, except in compliance with the provisions of Sections 4945(g) or (h) of the Code, as the case may be.

f) You confirm your obligation to maintain separate records regarding the receipt and expenditure of the grant and to make its books and records available to CMB at reasonable times if requested. You will maintain these books and records for at least four years after expending the grant funds.

g) Upon the expiration of this agreement, you will return to CMB any part of the grant that is not expended or committed for the grant purpose. If any part of the grant is not expended or committed for the grant purpose, you will notify CMB in writing, whereupon CMB will have the sole right to approve carry-forward of funds or a no cost time extension. Either party may terminate this agreement upon thirty [30] days written notice to the other party. In the event of early termination, you agree to return any funds not committed or expended in accordance with THE PURPOSE OF THE GRANT and provide an accounting as to the use of expended or committed funds up to the date of termination.

h) Any publicity derived from this grant, including publications, presentations, and printed materials, should acknowledge CMB's financial support of this project.

i) CMB encourages all investigators to share data whenever feasible. If the original data have been collected by the investigator using CMB funding, the data set should be released after the scientist has had sufficient time and opportunity to analyze and publish results.

To ensure CMB funds are expended in conformity with the agreed upon purposes, CMB may monitor the grant, including reviews or audits of financial and other records.

To indicate that your organization understands and accepts the terms of the grant and the attached budget, please countersign and send the enclosed copy of this letter by November 10, 2024 to Program Manager of CMB Beijing Representative Office, Ms. Iris Zhu, (izhu@cmbfound.org).

CMB is pleased to provide this grant. We wish you and your colleagues every success in achieving its stated purposes. If you have any questions, please contact Ms. Zhu.

Sincerely yours,

Roger I. Glass, MD, PhD
President
China Medical Board

Attachments: I. Approved Budget; Il. Reporting Schedule; Ill. Payment Instructions

ACCEPTED AND AGREED:

By: WU Peixin
Title: Chairman, Peking Union Medical College Education Foundation
(Printed name and title)

Signature: _____ Date: _____
(Signature, date and institution's official seal)

Cc: LIU Jiuchang; WANG Ye; John Lichten; Wenkai Li; WANG Yu

Attachment I

APPROVED BUDGET

Grant Number 24-564

January 1, 2025 – December 31, 2027

Items	**Amount ($)**
Personnel costs and consultants	60,000
Equipment and materials	15,000
Travel and conference	15,000
Publication and dissemination	5,000
Administrative cost	5,000
TOTAL	**$100,000**

Attachment II

REPORTING SCHEDULE

Grant number 24-564

Reports should be submitted electronically to the attention of Ms. Iris Zhu at izhu@cmbfound.org on the following schedule:

Report Due Date	Report Type
March 31, 2026	Annual Narrative and Financial report for expenditures between January and December 2025
March 31, 2027	Annual Narrative and Financial report for expenditures between January and December 2026
March 31, 2028	Final Narrative and Financial Report for expenditures between January 2025 and December 2027

Attachment III

PAYMENT AND BANKING INSTRUCTIONS

The CMB will use a wire transfer for payment of grant funds in Chinese Yuan. Please provide ALL banking information as required in Chinese.

请将下面电汇所需信息以中文填写完整。

a. Name of Bank Account Holder 收款机构账户名

b. Bank Account Number 收款机构人民币账户号

c. Bank Name 开户银行（具体到支行名称）

d. Address of Bank 开户银行地址（具体到省市区）

Artificial intelligence-assisted chest X-ray in TB screening: effectiveness of enhancing the care cascades in Chinese primary-care settings (ACCESS-CARE)

1. Cover Letter

Dear CMB Grant reviewers:

I am writing to introduce myself as an Assistant Professor at the School of Population Medicine and Public Health, Chinese Academy of Medical Sciences & Peking Union Medical College (CAMS&PUMC), and to express our keen interest in applying for a grant through the esteemed China Medical Board (CMB). Our institution, with its rich history and deep-rooted connection to the CMB, stands at the forefront of medical education and research in China.

In the era of digital health, where technology has the potential to transform lives, our project is a timely response to the persistent challenge of tuberculosis (TB). The idea for this project was inspired by the need for innovative solutions in early TB detection, aligning with the CMB's vision of harnessing technology for health improvement.

This pioneering project integrates artificial intelligence (AI) into chest X-ray (CXR) screening at primary healthcare facilities in China. By conducting a clustered controlled trial, we aim to evaluate the effectiveness of AI-assisted chest X-ray (CXR) screening in improving the TB care cascade in Chinese primary-care settings. The results of our project are expected to help developing a sustainable TB screening strategy that can be widely implemented, thereby enhancing the timeliness and accuracy of TB diagnosis.

My educational background in Epidemiology and Biostatistics, coupled with my professional experience in digital health and TB control, has prepared me to lead this project. I am honored to collaborate with esteemed colleagues Wei Liu, Zhongjie Li, and Xiaoyou Su, all of whom share a passion for improving TB care and are integral to the success of our project. Regarding Wei Liu, our acquaintance began at the JF Intelligent Healthcare Medical Technology Academic Conference where we forged a strong professional relationship. Their expertise in TB will be invaluable in ensuring the project's scientific rigor.

We appropriate it that the CMB plays a pivotal role in facilitating international collaboration. We believe that the CMB's network and resources can support the exchange of knowledge and best practices, ensuring that our project's findings are not only locally impactful but also contribute to the global fight against TB.

Thank you for considering our application. I am available for further discussion and would be delighted to provide additional information if required.

Sincerely,

Wang Ye

School of Population Medicine and Public Health, CAMS&PUMC

2. Cover Page

- ***Project details**:*

  - ***Project Title:*** Artificial intelligence-assisted chest X-ray in TB screening: effectiveness of enhancing the care cascades in Chinese primary-care settings (ACCESS-CARE)
  - ***Proposed Total Budget:*** $100,000
  - ***Project Duration:*** 3 years (2025.01-2027.12)

- ***PI Information:***

  - ***Full name:*** **Ye Wang** 王也
  - ***Contact Information:*** +86-13552881677 Email: wangye_pumc@163.com
  - ***Professional Title:*** Assistant Professor
  - ***Institution:*** School of Population Medicine and Public Health, China Academy of Medical Sciences & Peking Union Medical College, Beijing, China
  - ***Institution Address:*** 31 Beijige Santiao, Dongcheng District, Beijing

- ***Co-PI(s) Information**:*

  - ***Full name:*** **Wei Liu,** 刘伟
  - ***Contact Information:*** +86-13588000511 Email: whhzliuwei@163.com
  - ***Professional Title:*** Chief Medical Officer
  - ***Institution:*** JF Intelligent Healthcare Medical Technology Co.
  - ***Institution Address:*** 1 Dongsanhuan South Road, Chaoyang District, Beijing

  - ***Full name:*** **Zhongjie Li** 李中杰
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  - ***Professional Title:*** Professor
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  - ***Full name:*** **Xiaoyou Su** 苏小游
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  - ***Professional Title:*** Professor
  - ***Institution:*** School of Population Medicine and Public Health, China Academy of Medical Sciences & Peking Union Medical College, Beijing, China
  - ***Institution Address:*** 31 Beijige Santiao, Dongcheng District, Beijing

3. Project Summary Statement in English

The global incidence rate and mortality of tuberculosis (TB) pose a challenge to achieving the goals set out in the tuberculosis eradication strategy and the SDGs by 2030. At present, timely and accessible early detection methods for tuberculosis are still a major obstacle. In this context, the emergence of artificial intelligence (AI), especially the AI-assisted chest X-ray (CXR) in the field of diagnostic imaging, has proved the potential to significantly improve the speed and accuracy of tuberculosis diagnosis. However, the extent to which these technologies can affect the broader tuberculosis care cascade, especially by reducing the diagnostic time in the population level, has not yet been explored. The proposed project plans to use the certified AI-assisted CXR system (JF CXR-1) for tuberculosis screening, which aims not only to integrate AI into the diagnosis process, but also to critically assess its impact on the overall tuberculosis care cascade. The selected location for this project is Yichang City in western Hubei Province, China, which is facing a high TB burden. The city has established a strong city-wide health big data platform ten years ago, providing the basis for this project. The project will first optimize the AI-assisted CXR system through retrospective imaging to validate the accuracy of case screening (Stage I). Secondly, the project will shift its focus to the real world, where cluster randomized controlled trials will be conducted in primary-care settings (Stage II). In this stage, the effectiveness of the AI-assisted CXR system in reducing the diagnostic time of TB cases will be evaluated by comparing with those settings without using the tool. In stage III, the qualitative and quantitative methods will be used to evaluate the generalization, practicality, and feasibility of extending the screening strategy in various community environments. If the AI-assisted screening strategy is proven accurate, effective, and sustainable, it may pave the way for its widespread adoption in primary healthcare institutions and other grassroots areas in China. This can not only improve the timeliness of tuberculosis diagnosis, but also help to allocate medical resources more effectively and significantly reduce tuberculosis-related incidence and mortality, bringing positive changes to global public health. In addition, the results of the project can also provide information for policy decisions and guide the formulation of strategies to prioritize the integration of AI into health care, which can not only fight against tuberculosis but also a series of other diseases.

4. Project Summary in Chinese

项目名称：

人工智能辅助胸片在结核病筛查中的应用：提高中国基层结核病照护级联的有效性

PI：

王也 助理研究员

联系方式：电话号码：13552881677; 邮箱：wangye_pumc@163.com

中国医学科学院北京协和医学院群医学及公共卫生学院

Co-PI：

刘伟 首席医疗官

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江西中科九峰智慧医疗科技有限公司

李中杰 研究员

联系方式：电话号码：13671194343；邮箱：lizhongjie@sph.pumc.edu.cn

中国医学科学院北京协和医学院群医学及公共卫生学院

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中国医学科学院北京协和医学院群医学及公共卫生学院

项目摘要：

全球结核病发病率和死亡率对实现 2030 年终止结核病战略和可持续发展目标构成了严峻挑战。当前，及时且易于获取的结核病早期诊断方法依旧是一个重要的难题。在此背景下，人工智能（AI）技术的兴起，尤其是在诊断成像领域中 AI 辅助的胸部 X 射线（CXR）技术，已经展现出其在显著提升结核病诊断速度和准确性方面的潜力。然而，这些技术在人群层面对结核病照护级联的影响，尤其是它们在缩短诊断时间方面的具体作用，尚未得到充分探索。

本项目拟采用 AI 辅助 CXR 系统（JF CXR-1）进行结核病筛查，旨在将人工智能技术整合到诊断流程中，并对其在整个结核病照护级联中的影响进行深入评估。项目将在湖北省宜昌市开展，该市结核病疾病负担较重，并且在十年前已建立了一个功能强大的全市健康大数据平台，这为本项目顺利开展提供了良好基础。

项目将分为三个阶段进行：第一阶段，通过对大数据平台影像资料的回顾性分析，对 AI 辅助 CXR 系统进行验证和优化，以验证其病例筛查的准确性；第二阶段，项目将转向现实世界，在基层医疗机构开展整群随机对照试验，通过与未使用该工具的对照组相比较，评估 AI 辅助 CXR 系统在缩短结核病诊断时间上的有效性；第三阶段，将形成 AI 辅助结核病筛查的策略，运用定性和定量研究方法，评估该策略在不同社区环境中的普适性、实用性和可行性。

若 AI 辅助筛查策略被证实准确、有效、可持续，它将有望为在基层医疗卫生机构中推广该技术铺平道路，从而在结核病的早期诊断和治疗中发挥重要作用。

5. Project Proposal

- ***Background and Rationale：***

Tuberculosis (TB) remains a formidable global health challenge (1, 2), with persistently high incidence and mortality rates threatening the achievement of the End TB strategy and the 2030 Sustainable Development Goals (3). Timely detection is crucial for improving patient outcomes and stemming disease transmission (4).

Digital radiography (DR) devices are widely used for disease diagnosis in multi-level healthcare facilities especially in the primary healthcare in low-resource settings. While in these settings, shortage of qualified and experienced radiologists is a big problem, which limits the early detection and diagnosis of TB by chest radiographs. Addressing these limitations, there is a growing focus on AI-based software for tuberculosis detection to improve diagnostic accuracy while reducing costs(5).

Positioning AI as a revolutionary tool within healthcare systems, its applications have extended to detecting extrapulmonary TB (6), and some studies suggest AI may outperform pulmonologists in interpreting pulmonary function tests (7). Advanced AI models developed from medical imaging and genetic data specifically aim to detect TB, differentiate infection from other pulmonary diseases, and identify TB drug resistance (8).

Currently, five AI algorithms have been certified for TB detection on chest radiographs. A study in Bangladesh evaluated the five AI algorithms for TB diagnosis using chest radiographs, comparing them with each other and with radiologists(9). All chest films were read independently by three radiologists and five AI algorithms, and all five AI algorithms performed significantly better than radiologists(10).

One of the five AI algorithms, ***JF CRX-1***, is the intellectual technology to be implemented and evaluated in this proposed project. JF CXR-1 is a simultaneous CXR detection CAD software based on CNNs that detects multiple thorax diseases including TB. The software has achieved an AUC of 0.94, a sensitivity of 0.91, and a specificity of 0.81, which meet the WHO's criteria for the target product profile(11), and has been externally validated(12). The JF CXR-1 has already been officially approved by the National Medical Products Administration as the Class III medical device registration certificate, which is the first Class III AI certificate in the field of TB in China. Considering the fact that the JF CXR-1 is developed based on the clinical-diagnostic TB cases, it is needed to be validated and optimized using the etiologically positive cases, which is going to be conducted in this project.

Until now, most studies have examined the accuracy of AI algorithms than traditional methods, while few have tested the effectiveness of AI-assisted CXR in reducing the disease burden of TB when it is implemented in mass screening in the real world. In this project, we aim to not only validate and optimize the AI algorithms in diagnosing etiologically positive TB cases but also evaluate how the AI-assisted system can help in early detection and diagnosis at the population level.

AI-driven CXR screening represents the potential in supporting medical decision-making, expanding screening capabilities, enhancing medical training, and promoting healthcare equity (13, 14), we wish the results of our research can help to format guidelines or strategies in TB screening that can be implemented in the domestic and global primary care settings.

➢ ***Aim and Objectives：***

The overarching aim of this project is to evaluate the effectiveness of AI-assisted CXR screening in improving the TB care cascade by reducing the time of detection and diagnosis among etiologically positive TB cases in Chinese primary-care settings. The specific objectives are:

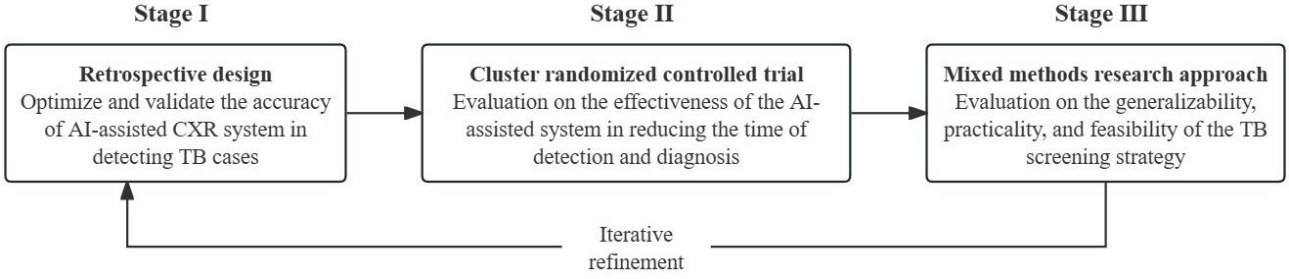
Objective 1: Using the retrospective chest radiography and case reports, to validate and optimize the AI-assisted CXR system and optimize its accuracy for the detection of etiologically positive TB cases.

Objective 2: Using a prospective cluster randomized controlled trial design, to evaluate the effectiveness of the AI-assisted CXR system in reducing the time of detection and diagnosis of etiologically positive TB cases when it is implemented in real-world primary healthcare settings.

Objective 3: Using the mixed methods research (MMR) approach based on the theory of the Technology Acceptance Model (TAM), to investigate the generalization, practicality, and feasibility of extending the AI-enhanced screening strategy in various community environments.

➢ ***Project Design：***

The study will be structured into three continuous stages. In the first stage, a retrospective study will be employed to validate and optimize the AI-assisted CXR system. In the second stage, the effectiveness of the optimized system in the real world will be evaluated in a prospective stratified clustered randomized controlled trial. In the third stage, mixed-method research will be conducted to evaluate the generalizability, practicality, and feasibility of the AI-assisted CXR system.



- **Stage I Validate and optimize the AI-assisted CXR system**

(1) Objective

By validating and optimizing the AI-assisted CXR system with retrospective chest radiography driven from the big-data platform in Yichang, the project aims to improve the system's ability to accurately identify etiologically positive TB cases.

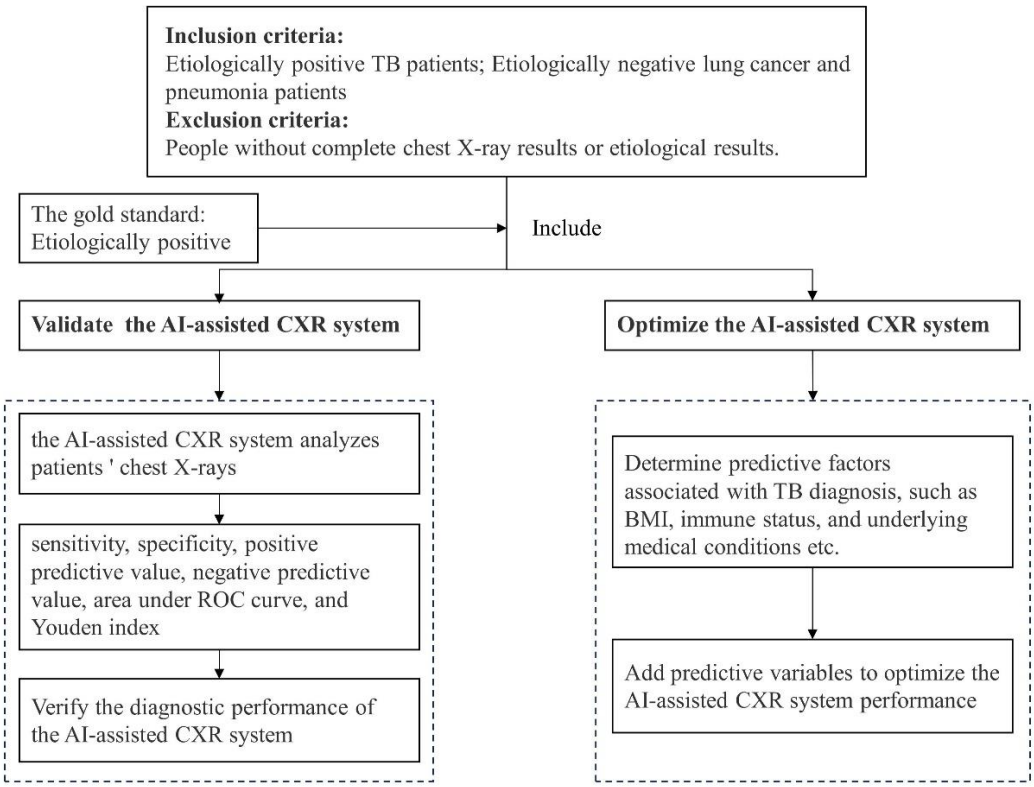
(2) Setting

The proposed study will be conducted in Yichang, a city located in the western part of Hubei Province, China. Yichang has faced a high TB burden in the past years, the incidence was up to over 100/100,000 in some townships, which is much higher than the average level in China. The disease burden calls for innovation in the field of early detection and diagnosis. This region is also notable for its well-established city-wide health big data platform, operational for over a decade, which provides a robust foundation for leveraging advanced technological tools such as AI in healthcare.

(3) Project Design

In this stage, the study is designed to extract all the confirmed etiologically positive TB cases recorded in the city-wide health big data platform in the past five years when this program launched. Those with diseases that can be misdiagnosed as TB (e.g., lung cancer, pneumonia) will be extracted as the matched controls. Chest X-ray images will be collected and analyzed using the AI-assisted CXR system. Etiologically positive will be considered the gold standard for diagnosing TB patients.

Upon establishing the robust diagnostic performance of the AI-assisted CXR system, the study intends to further refine the existing algorithm by incorporating predictive variables associated with TB diagnosis, including Body Mass Index (BMI), immune status, underlying medical conditions, etc.



(4) Study Population

Registered patients in city-wide health big data platform in Yichang City diagnosed with TB, as well as those with lung cancer, and pneumonia.

(5) Inclusion and Exclusion Criteria

Inclusion criteria: Etiologically positive TB cases; Etiologically negative lung cancer and pneumonia patients.

Exclusion criteria: People without complete chest X-ray results or pathogenic results.

(6) Study Indicators

Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), area under ROC curve (AUC), and Youden index of the AI-assisted CXR system.

(7) Sample Size

The sample size can be calculated using the formula:

$$N_+ = \frac{\left(z_\alpha\sqrt{V(\theta_0)} + z_\beta\sqrt{V(\theta_1)}\right)^2}{(\theta_1 - \theta_0)^2}$$

θ_0 is the ROC area of the null hypothesis (0.865). θ_1 is our expected ROC (0.950). V is the variance. Z_α and Z_β are the Z values corresponding to the values of α and β.

A two-group (positive/negative or with condition/without) design with continuous response data will be used to test the area under the ROC curve against the null value of 0.865. The comparison will be made using a two-sided Z-test with a Type I error rate (α) of 0.05. The area under the curve will be computed across the entire X-axis (false positive rate) range of 0 to 1. To detect an area under the curve of 0.95 with 95% power, the number of subjects needed will be 83 in the positive group and 83 in the negative group.

In practice, we design to include all the cases in the database, with enough sample size to meet the need.

(8) Statistical Analysis

Using the diagnosis of the etiologically positive TB as the gold standard, the diagnostic performance of the AI-assisted CXR system will be evaluated by calculating sensitivity, specificity, PPV, NPV, the AUC along with the 95% confidence interval, and Youden index. as detailed in Table 1.

Table 1 Diagnostic Test Contingency Table

the AI-assisted CXR system	Etiological results		Total
	Positive	Negative	
Positive	True Positive A	False Positive B	A+B
Negative	False Negative C	True Negative D	C+D
Total	A+C	B+D	N

Note: sensitivity =A/(A+C)×100%; specificity =D/(B+D) ×100%; PPV: A/(A+B) ×100%; NPV: D/(C+D) ×100%; Youden index: (sensitivity+ specificity)-1

- **Stage II Evaluation of the effectiveness of the AI-assisted CXR system in reducing the time of detection and diagnosis of TB cases**

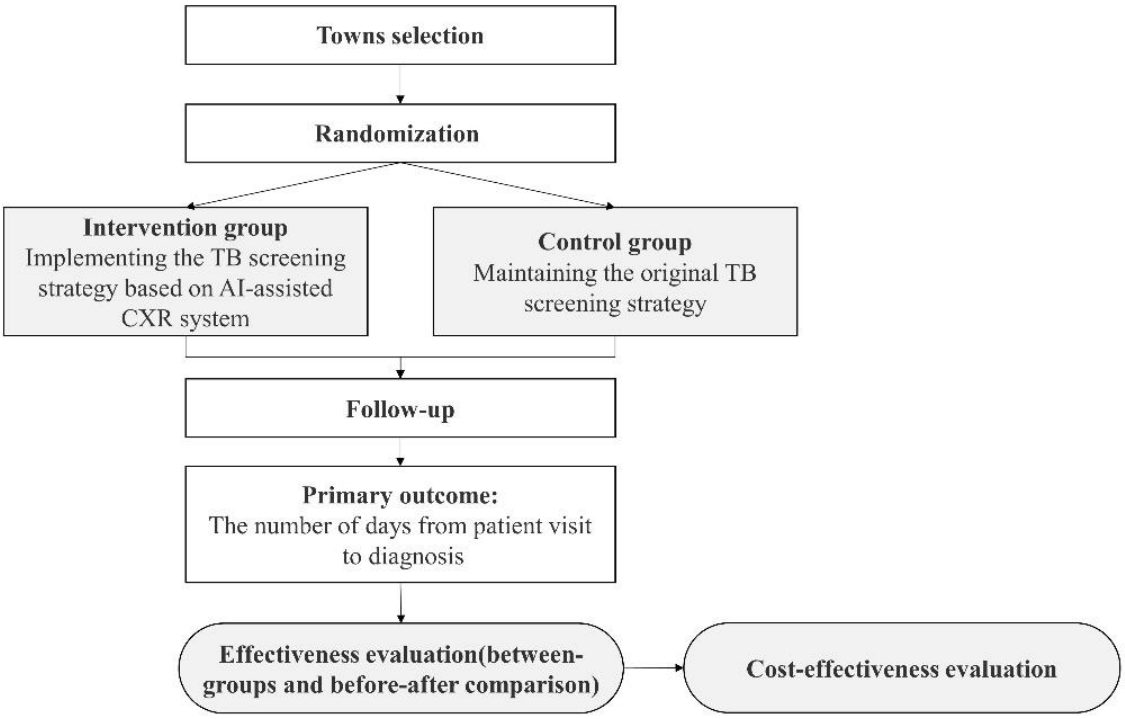
(1) Aim and Objectives

To test whether the AI-assisted CXR system can reduce the time of detection and diagnosis of etiologically positive TB cases when it is implemented in the real-world setting, by carrying out a cluster-randomized controlled trial.

(2) Study Design

A cluster-randomized controlled trial will be conducted at the township level in Yichang. The stratification will be grounded before the randomization based on the average reported TB incidence rates from the past three years among the 86 townships in Yichang. These rates will be

classified into lower tier (below 100/100,000) and higher tier (more than 100/100,000). Then the towns in each tier will be randomly allocated into the intervention or control group with the corresponding TB screening strategy. All TB cases screened in the following 12 months will be included in the study.



(3) Intervention and Control Group

Intervention group: The intervention involves utilizing the AI-assisted CXR system. This system analyzes chest radiographs to identify potential signs of TB. Positive results flagged by the AI require further assessment by a physician or specialist to confirm the diagnosis. Following confirmation, detailed diagnostic tests such as sputum smear microscopy, culture tests, or molecular biology diagnostics are conducted.

Patients diagnosed with TB will receive a personalized treatment plan tailored to their specific condition, which might include medication therapy, regular follow-ups, and lifestyle adjustments. Information on TB, guidance on treatment options, and advice on lifestyle changes will be provided.

Control group: The control group will use conventional methods for TB screening which do not involve the AI-assisted CXR system. These methods include standard chest X-ray analysis and physical examination.

(4) Outcomes Evaluation

Primary outcome: The difference in the average number of days from patient visit to diagnosis between the intervention and the control group.

Secondary outcome: The exploratory outcomes include the difference between the intervention and the control group in the number of TB cases, and the above changes in the intervention group after the implementation of the AI-assisted TB screening strategy.

Economic evaluation: The cost-effectiveness of utilizing the AI-assisted TB screening strategy will be assessed.

(5) Sample Size

The sample size calculation based on primary outcome will consider differences between mean number of days from patient visit to diagnosis between different groups, using the following formula:

$$2mk=2N\times[1+\rho(\bar{m}-1)]$$

k is the sample size of the cluster, $\bar{m}$ is the average cluster size, N is the sample size required for each group of the corresponding individual randomized trial, and ρ is the intra-cluster correlation coefficient (ICC). In this study, the $\bar{m}$=40, k=2, ρ is presumed to be 0.2, N can be calculated from:

$$n_1=n_2=\frac{2(Z_{\alpha/2}+Z_{\beta})^2\times\sigma^2}{(\mu_2-\mu_1)^2}$$

in which, $Z_{\alpha/2}$ is 1.96, Z_{β} is 1.28, μ_2-μ_1 is presumed to be 3, σ is presumed to be 2. The N will be 10. As the result, in the cluster-randomized controlled design, the total number of cases need to be included will be 176. It is expected that over 3,000 TB cases will be included during our study, which can meet the required sample size.

(6) Statistical analysis

All TB cases screened during the study period will be included in the study. Data analysis will be mainly performed according to the intention-to-treat approach.

For primary outcome evaluation, statistical comparisons between intervention and control groups for the average diagnostic time and other continuous variables of confirmed TB cases will be made using regression analysis with robust SEs accounting for clustering. Subgroup analysis will be conducted according to different purposes.

For secondary outcome evaluation, all TB-related cases detected will be included in data analysis, and difference test between intervention and control groups will be performed in the numbers of TB-related cases detected and confirmed TB cases. The same method will be used to analyze the changes before and after the implementation of the AI-assisted TB screening strategy within the intervention group.

In addition, a suitable cost-effectiveness analysis model will be established to assess the cost and benefits of utilizing the AI-assisted TB screening strategy in these experimental towns in Yichang.

- **Stage III Acceptance of the AI-assisted CXR system in various populations**

(1) Objectives

This stage aims to assess the generalizability, practicality, and feasibility of the AI-assisted CXR system based on TAM theory, ultimately integrating the evidence from stage I and stage II to develop practical guidelines for TB screening using the AI-assisted CXR system.

(2) Study Design

This is a cross-sectional study utilizing a mixed methods research (MMR) approach based on the theory of the Technology Acceptance Model (TAM). TAM is a theoretical model that includes 4 influencing factors of system usage: perceived usefulness, perceived ease of use, attitude toward using the system, and behavioral intention. A TAM-based quantitative survey will be conducted to analyze the influencing factors of the willingness to use the AI-assisted CXR system among healthcare workers, TB patients, and relevant local government officials. Additionally, TAM-based offline focus group interviews will be conducted to explore the attitudes, acceptance levels, and influencing factors concerning the AI-assisted CXR system among healthcare workers, TB patients, and government officials, and their political suggestions for the system.

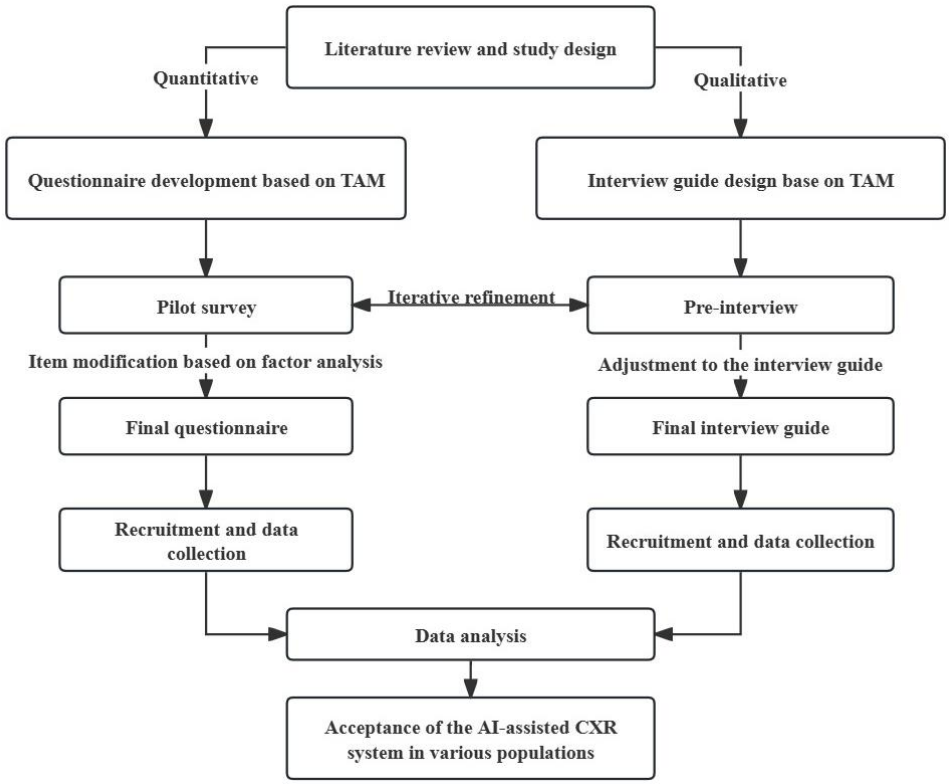
(3) Research indicators

Outcome: Willingness to use the AI-assisted CXR system.

Factors: External variables (such as demographic data), perceived ease of use, perceived usefulness, and attitude towards the AI-assisted CXR system.

(4) Setting

The research setting will be the primary healthcare institutions in Yichang involved in this project. The data will be collected using convenience sampling.



(5) Eligibility criteria

Inclusion criteria: (1) Over 18 years old; (2) Healthcare workers with professional qualifications and have ever used the AI-assisted CXR system; TB patients diagnosed using the AI-assisted CXR system; relevant government officials; (4) Willing to participate and sign an informed consent form.

Exclusion criteria: For quantitative research: Not proficient in Chinese.

For qualitative research: (1) Those showing significant discomfort, hesitation, or avoidance regarding privacy issues that prevent continuation of interviews; (2) Those who provide short, irrelevant responses during interviews.

(6) Sample size

For the quantitative research, the sample size will be at least ten times the number of scale items based on the 10 Events Per Variable (10 EPV) principle. Assuming an average of 3 items would be assigned to each dimension of the TAM, 120 samples will be required. Considering an effective recovery rate of 80%, at least 150 participants will be required.

For the qualitative research, the actual sample sizes will be determined based on the data saturation.

(7) Instruments

A survey questionnaire and an interview guide will be developed following an iteration process based on the TAM model, expert suggestions, and a pilot study. The questionnaire and interview guide will include demographic information and items based on TAM with 4 dimensions: perceived ease of use, perceived usefulness, attitude towards using the AI-assisted CXR system, and willingness to use the AI-assisted CXR system.

(8) Statistical Analysis

For quantitative research, statistical descriptions will be used to describe perceived ease of use, perceived usefulness, attitude towards using the AI-assisted CXR system, and willingness to use. Linear regression and structural equation modeling will be used to identify factors associated with the willingness to use the system. For qualitative research, "Colaizzi's phenomenological approach" will be used for analysis.

- ***Limitations：***

One limitation is that we evaluate AI+DR in this study, as DR is currently mainly used at the township level in rural areas in China. In many urban healthcare facilities, CT but not DR is more commonly used. Therefore, in the future, it is necessary to further explore the strategy of AI+CT for TB screening in various settings. Secondly, this project will last for only three years, and some more crucial indicators such as mortality and morbidity may not be evaluated in such a short term.

- ***Pilot study：***

A pilot study will be conducted in all continuous three stages. In the first stage, we will involve 50 TB cases and 50 controls to initially assess the AI-assisted CXR system. In the second stage, two towns in the intervention group and two towns in the control group will be included to test the whole process. In the last stage, five people from each category will be invited. This will provide preliminary insights into the performance and potential adjustments needed for the AI-assisted CXR system before a full-scale trial.

- ***Outcomes, Dissemination, and Sustainability：***

The project anticipates the development of a refined AI-assisted CXR system and a sustainable TB screening strategy. It expects to generate a more precise AI-assisted CXR system and a feasible strategy for TB screening in Chinese primary-care settings. With the implementation of the AI-assisted strategy, we expect to see enhanced TB care cascades especially reduced time of detection

and diagnosis. Outcomes will be disseminated through academic publications, conferences, and policy briefings. Sustainability is ensured by integrating the AI system into existing healthcare infrastructure and training local staff.

- ***Feasibility and Risk Assessment：***

The project's feasibility is supported by the established health big data platform in Yichang and the expertise of the multidisciplinary team. Risks, such as technological failures or adoption resistance, will be mitigated through continuous system updates, stakeholder engagement, and iterative training programs. Each team member offers knowledge, skills, and networks that can contribute to ensuring the project's feasibility and successful completion within a 36-month timeframe.

- ***Monitoring and Evaluation：***

Project progress will be monitored using key performance indicators (KPIs) aligned with project objectives. Evaluation will involve both quantitative analysis of care cascade metrics and qualitative assessment of system usability and impact.

Monitoring of the research process

Ye Wang, the PI, will oversee the study design and implementation throughout the process, to ensure research activities meet the milestones.

Major monitoring activities will be conducted, to ensure:

- ✓ Achieving the objectives of all the study phases.
- ✓ All quantitative research tools are properly designed, pilot-tested, and revised.
- ✓ All data collectors are properly trained and understand the procedure and content.
- ✓ All local partners understand the significance, requirements, and anticipated outcomes so that the study is implemented smoothly and completely.
- ✓ Data entry, cleaning, coding, and analysis are completed on time, and the method of data analysis is appropriate.
- ✓ Progress to be systematically tracked and annually reviewed both internally and with CMB.

➢ ***Timeline and Milestones：***

Activities and Milestones	YEAR 1												YEAR 2												YEAR 3											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Ethic review																																				
PILOT STUDY																																				
Pilot study preparation																																				
Pilot data extraction																																				
Pilot interview																																				
Program revision																																				
STAGE I																																				
Retrospective collection of images																																				
Cases inclusion and exclusion																																				
AI-assisted CXR system validation																																				
AI-assisted CXR system optimization																																				
STAGE II																																				
Pre-intervention survey																																				
Design of the intervention program																																				
Implementation of the AI-assisted screening																																				
Data management and analysis																																				
STAGE III																																				
Design of questionnaire																																				
Interview with participants																																				
Data analysis																																				
FULL PROJECT																																				
Report and publication																																				
Formation TB screening strategy and raise policy proposals																																				

6. References:

1. Phillips JA. Global Tuberculosis. Workplace Health Saf. 2015;63(10):476.
2. Orcau À, Caylà JA, Martínez JA. Present epidemiology of tuberculosis. Prevention and control programs. Enferm Infecc Microbiol Clin. 2011;29 Suppl 1:2-7.
3. Fitchett JR, MacPherson P, Corbett EL. Implementing the End TB Strategy and the intersection with the Sustainable Development Goals, 2016-2030. Trans R Soc Trop Med Hyg. 2016;110(3):145-7.
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5. Du J, Su Y, Qiao J, Gao S, Dong E, Wang R, et al. Application of artificial intelligence in diagnosis of pulmonary tuberculosis. Chinese medical journal. 2024;137(5):559-61.
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7. Topalovic M, Das N, Burgel PR, Daenen M, Derom E, Haenebalcke C, et al. Artificial intelligence outperforms pulmonologists in the interpretation of pulmonary function tests. Eur Respir J. 2019;53(4).
8. Liang S, Ma J, Wang G, Shao J, Li J, Deng H, et al. The Application of Artificial Intelligence in the Diagnosis and Drug Resistance Prediction of Pulmonary Tuberculosis. Front Med (Lausanne). 2022;9:935080.
9. Santosh KC, Allu S, Rajaraman S, Antani S. Advances in Deep Learning for Tuberculosis Screening using Chest X-rays: The Last 5 Years Review. Journal of medical systems. 2022;46(11):82.
10. Qin ZZ, Ahmed S, Sarker MS, Paul K, Adel ASS, Naheyan T, et al. Tuberculosis detection from chest x-rays for triaging in a high tuberculosis-burden setting: an evaluation of five artificial intelligence algorithms. The Lancet Digital health. 2021;3(9):e543-e54.
11. Yang Y, Xia L, Liu P, Yang F, Wu Y, Pan H, et al. A prospective multicenter clinical research study validating the effectiveness and safety of a chest X-ray-based pulmonary tuberculosis screening software JF CXR-1 built on a convolutional neural network algorithm. Frontiers in medicine. 2023;10:1195451.
12. Qin ZZ, Van der Walt M, Moyo S, Ismail F, Maribe P, Denkinger CM, et al. Computer-aided detection of tuberculosis from chest radiographs in a tuberculosis prevalence survey in South Africa: external validation and modelled impacts of commercially available artificial intelligence software. The Lancet Digital health. 2024.
13. Sachedina D, Hooda R, Fawaz B. Practical applications of artificial intelligence in dermatology residency training. Clin Exp Dermatol. 2024;49(8):925-6.
14. Al-Naser Y. How medical radiation technologists can foster equity, diversity, and inclusion through artificial intelligence in radiology. J Med Imaging Radiat Sci. 2024:101436.

7. Budget

- ***Budget Table***

Category	Year 1	Year 2	Year 3	Total
Personnel and Consultants	25,000	20,000	15,000	60,000
Equipment, Materials, and Supplies	5,000	5,000	5,000	15,000
Travel	5,000	3,000	2,000	10,000
Conferences	3,000	1,000	1,000	5,000
Publication and Dissemination	0	2,500	2,500	5,000
Administrative Costs	2,000	1,500	1,500	5,000
Total	40,000	33,000	27,000	100,000

- ***Narrative Explanation of Budgetary Item***

Personnel and Consultants:

Year 1: $25,000 - Initial setup and optimization of AI-assisted CXR system;

Year 2: $20,000 - Implementation and monitoring of TB screening strategy;

Year 3: $15,000 - Data analysis and formulation of sustainable TB screening strategy.

Equipment, Materials, and Supplies:

Year 1: $5,000 - Initial purchase for AI-assisted CXR system setup;

Year 2: $5,000 - Scale-up with additional hardware and software for expanded screening;

Year 3: $5,000 - Equipment maintenance and supplies for project completion.

Travel:

Year 1: $5,000 - Travel for initial setup, training, and international conference;

Year 2: $3,000 - Travel for monitoring and evaluation;

Year 3: $2,000 - Travel for final evaluation and dissemination.

Conferences:

Year 1: $3,000 - Fees and travel for presenting preliminary findings;

Year 2: $1,000 - Participation in local and regional conferences;

Year 3: $1,000 - Dissemination of final results at conferences.

Publication and Dissemination:

Year 1: $0 - No planned publications or major dissemination activities;

Year 2: $2,500 - Publication fees, conference fees, and dissemination materials;

Year 3: $2,500 - Publication fees, conference fees, and dissemination materials.

Administrative Costs:

Year 1: $2,000 - General administrative expenses during initial setup;

Year 2: $1,500 - Reduced administrative support as the project progresses;

Year 3: $1,500 - Administrative costs for project completion and integration.

- ***Other Monetary Support (if applicable)***

There's no other monetary support.

8. Concise CVs of PI and Co-PIs

Ye Wang, PhD

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Email: wangye_pumc@163.com

Date of birth: September 28, 1993

Educational Background

2018-2021	PhD	**Epidemiology and Biostatistics, Peking Union Medical College, Beijing, China** Thesis title: *Association of Obesity with Environmental Factors and MC4R Gene polymorphism in Yi People in Liangshan Prefecture, Sichuan Province* Supervisor: Guangliang Shan
2016-2018	Master	**Epidemiology and Biostatistics, Peking Union Medical College, Beijing, China**
2011-2016	Bachelor	**Preventive Medicine, Soochow University, Suzhou, China**

Professional Experience

2021.8-present	**Assistant professor,** School of Population Medicine and Public Health, Peking Union Medical College, Chinese Academy of Medical Sciences
2023.11-present	**Deputy director,** Office of Discipline Development, School of Population Medicine and Public Health, Peking Union Medical College, Chinese Academy of Medical Sciences
FIELDS OF INTEREST:	**Digital health, TB, Respiratory disease, Prediction model, Epidemiologic methods, Real-world study**

Grants

Early accurate assessment and comprehensive intervention of major chronic respiratory diseases, CAMS Innovation Fund for Medical Sciences, 2021-2025 (Sub-project: Development and validation prediction model for chronic respiratory disease based on fine classification, PI)

Research & Project Experience

Life-course cohort study and digitalization construction in Chinese Academy of Medical Sciences, CAMS Innovation Fund for Medical Sciences, 2020-2021

General population cohort study in Beijing-Tianjin-Hebei, National Key Research and Development Plan-Key Project of Precision Medicine Research, 2016-2021

Longitudinal comparison and prediction of cardiovascular and metabolic risk in Yi migrants, National Natural Science Foundation of China, 2012-2015

China national health survey and basic physiological parameters (Phase II), Science and Technology Basic Work Project, 2013-2017

Awards and Honors

APSR Young Investigators Travel Award, 27th Congress of the Asian Pacific Society of Respirology, Singapore, November 2023.

Outstanding Graduates Award, Peking Union Medical College, June 2021

Outstanding Presentation Award, 8th National Conference of Epidemiology, China, July 2019

Outstanding Graduates Award, Medical College, Soochow University, June 2016

Selected Publications

Published

1. **Wang Y**, He R, Ren X, Huang K, Lei J, Niu H, Li W, Dong F, Li B, Yang T, Wang C. Developing and validating prediction models for severe exacerbations and readmissions in patients hospitalised for COPD exacerbation (SERCO) in China: a prospective observational study. *BMJ Open Respir Res*. 2024 May 7;11(1):e001881.

2. **Wang Y**, Pan L, He H, Li Z, Cui S, Yang A, Li W, Jia G, Han X, Wang X, Shan G. Prevalence, associated factors, and gene polymorphisms of obesity in Tibetan adults in Qinghai, China. *BMC Public Health.* 2024 Jan 26;24(1):305.

3. **Wang Y**, He R, Dong F, Liu D, Ren X, Yang T, Wang C. Re-exacerbation within 30 days of discharge is associated with poor prognosis in the following year among patients hospitalised with exacerbation of chronic obstructive pulmonary disease: a clinical cohort study. *BMJ Open Respir Res.* 2023 Aug;10(1):e001759.

4. He R, Ren X, Huang K, Lei J, Niu H, Li W, Dong F, Li B, **Wang Y**#, Yang T#, Wang C. Influenza and pneumococcal vaccination coverage and associated factors in patients hospitalized with acute exacerbations of COPD in China: Findings from the real-world data. *Chin Med J (Engl).* 2023 Jul 24. (Co-corresponding author)

5. Ren X*, **Wang Y***, He R, Dong F, Liu D, Yang T, Wang C. Mortality and readmission risk for hospitalised patients with acute exacerbation of COPD with and without spirometric obstruction: a longitudinal observational study in China. *BMJ Open.* 2023 Jun 5;13(6):e071560. (Co-first author)

6. **Wang Y**, Pan L, Wan S, Yihuo W, Yang F, Li Z, Yong Z, Shan G. Body fat and muscle were associated with metabolically unhealthy phenotypes in normal weight and overweight/obesity in Yi people: A cross-sectional study in Southwest China. *Front Public Health.* 2022 Oct 6;10:1020457.

7. **Wang Y**, Pan L, Wan S, Yihuo W, Yang F, He H, Li Z, Yong Z, Shan G. MC4R Gene Polymorphisms Interact With the Urbanized Living Environment on Obesity: Results From the Yi Migrant Study. *Front Genet.* 2022 Apr 14;13:849138.

8. **Wang Y**, Pan L, Wan S, Yi H, Yang F, He H, Li Z, Yong Z, Shan G. Association of Socioeconomic Status and Overweight/Obesity in Rural-to-Urban Migrants: Different Effects by Age at Arrival. *Front Public Health.* 2020 Dec 17;8:622941.

9. **Wang Y**, Pan L, Wan SP, Yi HW, Yang F, He HJ, Li Z, Zhang J, Yong ZP, Shan GL. Association between age at arrival, duration of migration, and overweight/obesity in Chinese rural-to-urban migrants: the Yi migrant study. *Chin Med J (Engl).* 2020 Aug 20;134(1):60-67.

10. **Wang Y**, Pan L, Wan S, Yi H, Yang F, He H, Li Z, Zhang J, Wang X, Yong Z, Shan G. Increasing prevalence of overweight and obesity in Yi farmers and migrants from 2007 to 2015 in China: the Yi migrant study. *BMC Public Health.* 2018 May 24;18(1):659.

11. He R, **Wang Y**, Ren X, Huang K, Lei J, Niu H, Li W, Dong F, Li B, Yang T, Wang C. Associations of medication regimen complexity with medication adherence and clinical outcomes in patients with chronic obstructive pulmonary disease: a prospective study. *Ther Adv Respir Dis.* 2023 Jan-Dec;17:17534666231206249.

Under Review

1. Effect of Glucocorticoid Administration Routes for Patients with Acute Exacerbations of Chronic Obstructive Pulmonary Disease in China: A Propensity Score-Matched Longitudinal Analysis

2. Understanding Psychological Symptoms Among Chinese College Students During the COVID-19 Omicron Pandemic: Findings from a National Cross-Sectional Survey in 2023

3. Prognostic Risk Prediction Models for Acute Exacerbation of Chronic Obstructive Pulmonary Disease: A Systematic Review

Digital Application

All-Health mini-app system, software copyright, 2023SR0749095, 2023

All-Health backstage management system, software copyright, 2023SR0749096, 2023

Previous Participation in CMB Activities

None.

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Brief Introduction

The Chief Medical Officer of JF Healthcare Co., Ltd., General Manager of the Tuberculosis and Infection Disease Control Division，and Executive Director of the Artificial Intelligence Network Laboratory of the National Medical Center for Infectious Disease.
At present, mainly engaged in the cross-disciplinary research and medical application of artificial intelligence and infectious diseases, the development of diagnostic products of infectious diseases.
He has published many SCI papers and undertaken many national and provincial major scientific research projects. He has rich work experience in many fields of medicine and health.
Doctoral supervisor of Shanghai Jiaotong University, external graduate supervisor of the School of Biomedical Engineering and Instrumentation Science of Zhejiang University.

Education

2011-2016	Postdoc	**Infectious Diseases, Department of Infectious Diseases, Huashan Hospital, Fudan University, Shanghai, China**
2005-2011	PhD	**Microbiology, School of Life Science Fudan University, Shanghai, China**
1997-2001	Bachelor	**Microbiology, Central China Agricultural University, Beijing, China**

Work experience:

2023.3-present	**JF Healthcare Co., Ltd. As the Chief Medical Officer,** General Manager of the Tuberculosis and Infection Disease Control Division, Executive Director of the Artificial Intelligence Network Laboratory of the National Medical Center for Infectious Disease.
2018.7-2023.2	**Joinstar Biotechnology Co.,** Ltd. As the Executive Deputy Director of the Shanghai Jiaotong University- Joinstar Medical Diagnostic Technology Joint Laboratory, the President of the Zhejiang Joinstar In Vitro Diagnostic High-tech Enterprise Research Institute.
2010.8-2018.7	Hangzhou Center for Disease Control and Prevention，Tuberculosis Prevention and Control Institute, **as the head of the Reference Laboratory for Tuberculosis,** Engaged in the field of molecular epidemiology, rapid diagnosis, drug resistance mechanism research, and quality control of tuberculosis laboratories in the city.
2001.8-2005.8	**East China Medicine Group Co.,** Ltd., Gene Technology Research Institute)，Engaged in the research and development of antibiotic drugs and genetically engineered drugs.

Research projects:

1. Twelfth Five-Year National Science and Technology Major Project: Research on the Clinical Treatment of Multi-Drug Resistant Tuberculosis, Sub-Project Leader (Project No. 2013ZX10003008-003)
2. Zhejiang Province's Key Project: Project Leader of Research and Development of Common Consumables and Reagents for Biomedical Laboratories (Project No. 2022C03002),
3. Zhejiang Province's Key Project: project leader of High-sensitivity Rapid Detection Technology and Products for COVID-19 Variants (Project No. 2022C03047),
4. Zhejiang Province's Key Project: Project leader of Disruptive Quick and Highly Sensitive COVID-19 Detection reagent (Project No. 2022C03187),
5.The first (set) key equipment engineering project in Zhejiang Province: Project leader of Fully automatic flow fluorescence chemiluminescence integrated analysis system and supporting core coding microspheres.

Major Industrialization Achievements:

1. The "Computer-Aided-Design X-ray Image for Tuberculosis Software" (JF CXR-1) (Registration Certificate No.: NMPA 20223211374), is the first Class III certificate in the field of infectious diseases and X-ray chest radiography, and has been Listed in STOP-TB partnership （which belong to the World Health Organization's）product list recommended.

Main Article:

Liu W, Chen J, Shen Y, et al., Phenotypic and genotypic characterization of pyrazinamide resistance among multidrug-resistant Mycobacterium tuberculosis clinical isolates in Hangzhou, China, *Clinical Microbiology and Infection* (2018),doi: 10.1016/j.cmi.2017.12.012. IF=6.11
2. Longxiang Xie, Wei Liu (co-first author), Qiming Li, et al. First Succinyl-Proteome Profiling of Extensively Drug-Resistant Mycobacterium tuberculosis Revealed Involvement of Succinylation in Cellular Physiology. Journal of Proteome Research, 2014,14(1):107-119,IF=4.51
3. Jing Wu, Wei Liu (co-first author), Lei He et al. Sputum Microbiota Associated with New, Recurrent and Treatment Failure Tuberculosis. PLoS ONE 2013,8(12)：e83445IF=3.73

Main Honors and Practical experience :

As the head of the reference laboratory for tuberculosis in Hangzhou, he led the city's tuberculosis quality control work, made beneficial contributions to the creation of a national demonstration area for the diagnosis and treatment of multi-drug resistant tuberculosis, and promoted the implementation of the Gates Foundation and Global Fund multi-drug resistant tuberculosis project in Zhejiang Province. He was awarded the National Science and Technology Major Special Project: Clinical Treatment Research on Multi-drug Resistant Tuberculosis.

The "Computer-Aided-Design X-ray Image for Tuberculosis Software" (JF CXR-1) (Registration Certificate No.: NMPA 20223211374), is the first Class III certificate in the field of infectious diseases and X-ray chest radiography, and has been Listed in STOP-TB partnership (which belong to the World Health Organization's）product list recommended.

Main academic positions:

1. Member of the Clinical Laboratory Committee of the Tuberculosis Branch of the Chinese Medical Association
2. Member of the Laboratory Medicine Expert Committee of the National Health Industry Association
3. Member of the Biological Diagnostic Technology Branch of the China Pharmaceutical Biotechnology Association
4. Member of the Expert Committee of the Zhejiang Provincial Quality Control Center for the Diagnosis and Treatment of Tuberculosis

Main Reports on national academic conferences

1. New technology of artificial intelligence screening for tuberculosis in lung imaging. The 34th National Academic Conference of the Chinese Anti-Tuberculosis Association. April 26, 2023. Xiamen, Fujian Province
2. New technology of AI screening for tuberculosis based on DR imaging data. The 2nd National Forum on Innovation in Tuberculosis, April 20, 2023. Haikou, Hainan
3. Utilizing artificial intelligence imaging screening technology to enhance the comprehensive prevention and control of tuberculosis on campus. The 4th National Academic Forum on the Prevention and Control of Tuberculosis and Common Infectious Diseases in Schools. June 16, 2023. Nanning, Guangxi
4. Application of AI imaging technology in active screening of tuberculosis. The 2nd Oriental International Infectious Diseases Academic Week and the National Infectious Diseases Medical Center (Shanghai) Cooperation Forum.
5. Adopting CAD imaging technology to improve the application of active screening for tuberculosis. The 3rd National Forum on Innovation in Tuberculosis and the 4th International Forum on Research and Development Cooperation in Tuberculosis in China.
6. Application of AI in the Active Detection of Tuberculosis, 6th Academic Conference of the Southwest Tuberculosis Hospital Alliance and the 2024 Annual Meeting.

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Date of birth: August 15, 1977

Brief Introduction

LI Zhongjie's main research field primarily focuses on the epidemiology of infectious diseases. His research interests include infectious disease transmission dynamics, disease surveillance and early alert, disease burden and evaluation of the effectiveness of interventions. He has been engaged in technical support and policy research for infectious disease surveillance and prevention and control in national disease control departments and research institutions for nearly twenty years. As the project leader, he has presided over several China key research and development plans, science and technology support plans, and National Nature Fund projects.

In the past five years, as the first author or corresponding author, he has published more than 20 academic papers on infectious disease epidemiology in international academic journals such as Lancet series and Nature series, and the research results have provided support for the formulation of national infectious disease prevention and control programs and policies.

Educational Background

2013-2016	PhD	**Epidemiology and health statistics, Chinese Center for Disease Control and Prevention, Beijing, China**
2001-2004	Master	**Epidemiology and health statistics, Chinese Academy of Preventive Medicine, Beijing, China**
1996-2001	Bachelor	**Preventive Medicine， School of Public Health, West China University of Medical Sciences，Sichuan, China**

Professional Experience

2023.9-present	**Assistant dean,** School of Population Medicine and Public Health, Peking Union Medical College, Chinese Academy of Medical Sciences, engaged in the overall coordination of scientific research, teaching and management.
2022.8-2023.9	**Section chief,** the National Bureau of Disease Control and Prevention, the Department of Infectious Disease Prevention and Control, Epidemiological Investigation and Public health Laboratory Division
2021.4-2022.8	**Section chief,** National Health Commission, Tuberculosis Prevention and Control Division of Disease Control Bureau
2014.12-2015.2	China provided assistance to the public health expert team on Ebola prevention and control in Sierra Leone, serving as the deputy head of the team

2012.9-2021.4 **Section chief,** Department of Infectious Disease Prevention and Control, Chinese Center for Disease Control and Prevention

Research & Project Experience

National Key Research and Development Plan, research and application demonstration of intelligent methods for social data-based management of major infectious diseases, Project leader (Project No. 2023YFC2308700)，2023-2026

National Science and Technology Major project, "Belt and Road" important infectious disease epidemic law and early warning and response technology research, Sub-Project Leader (Project No. 2018ZX10101-002)，2018-2020

National Natural Science Foundation of China, Epidemiological Research on Asymptomatic Infection of Novel Coronavirus -- Central China (Hubei), Sub-Project Leader (Project No. 82041029)，2020-2021

National key research and development Plan, key measures for the prevention and control of infectious diseases and emergency plan system research, Sub-Project Leader (Project No. 2021YFF0306002)，2021-2022

Major Industrialization Achievements

Invention patent "Method for Monitoring and Warning of Infectious Disease Symptoms with Multivariate Data in Large scale Activities"

Selected Publications

1.Li ZJ, Chen Q, Feng L, et al Active case finding with case management: the key to tackling the COVID-19 pandemic. Lancet. 2020 Jul 4;396(10243):63-70. IF:168.9

2. Li ZJ, Zhang HY, Ren LL, et al.Etiological and epidemiological features of acute respiratory infections in China. Nature Communications .2021 Aug 18;12 (1):5026.IF:16.6

3.Li ZJ, G.F. Gao, et al. Infectious disease trends in China since the SARS outbreak.The Lancet Infectious diseases .2017. 17(11): p. 1113-1115. IF:56.3

4. Li ZJ, Liu F,CuiJ,et al.Comprehensive large-scale nucleic acid-testing strategies support China's sustained containment of COVID-19. Nature Medicine .2021May;27(5):740-742. IF:82.9

5. Li ZJ, Yu LJ, Zhang HY, et al.Broad Impacts of Coronavirus Disease 2019 (COVID-19) Pandemic on Acute Respiratory Infections in China: An Observational Study. Clinical Infectious Diseases .2022 Aug 24;75(1): e1054 -e1062.IF:21.0

Main Honors and Practical experience

From April 2021 to August 2022, he served as the director of the Tuberculosis Prevention and Control Department of the Disease Prevention and Control Bureau of the National Health Commission, and has been involved in the formulation of national TB control planning, norms and technical guidelines for many times. He won the honor of "exemplary individual in the National Science and Technology System to Fight COVID-19" issued by the Ministry of Science and Technology. He served as an expert of the Disease Control Expert Advisory Committee of the National Health Commission, and the leader of the COVID-19 Emergency Response Prevention and Control Technical Team of the China Center for Disease Control and Prevention, and submitted more than 20 prevention and control policy recommendations and professional research and judgment reports to the country based on scientific research achievements.

In 2020, the research team led by him won the title of "National Advanced Collective in Fighting COVID-19". In the future, we will continue to focus on the research of response strategies and

technologies for potential infectious diseases during pandemics, with a particular emphasis on emerging technologies such as big data and artificial intelligence. We will accelerate their technological innovation in the field of infectious disease monitoring, early warning, and prevention, effectively promote their transformation and application, and significantly enhance China's ability to prevent and control sudden new infectious diseases.

He has rich experience in scientific research and prevention and control practices in national level institutions, understands the major strategic needs in the field of national infectious disease prevention and control, deeply participates in the formulation of national prevention and control policies and measures, and has sensitive judgment on scientific and technical issues that are prioritized for research. The recommender can effectively promote practical scientific and technological innovation research, guide and influence more research teams across the country to carry out urgently needed scientific research work, promote the comprehensive improvement of China's scientific research capabilities in the field of monitoring, early warning, and prevention and control of sudden and new infectious diseases, and cultivate a group of scientific and technological talents in the field of infectious diseases who can solve practical and complex problems for the country.

Main academic positions

1. The applicant's research field is infectious disease epidemiology, with nearly 20 years of experience working on the front line in national level disease control departments and research institutions. They have strong identification ability for major scientific and key technical issues in national infectious disease prevention and control.

2. Led the team to successfully organize and carry out a number of national large-scale scientific research tasks such as the national pathogenic spectrum of respiratory infection, serological investigation of COVID-19 infection, research, transformation and application of monitoring and early warning technology system, and has high academic influence and professional leadership in this field. Published over 10 research papers as the first author and corresponding author in top international journals such as Lancet and its sub journals, Nature Medicine, etc;

3. As a core expert, he participated in the organization and formulation of the National COVID-19 Prevention and Control Plan (Version 1-10), and many research achievements were adopted by the national prevention and control technical plan.

4. He is the leader of the infectious disease discipline at the School of Group Medicine and Public Health, Peking Union Medical College, Chinese Academy of Medical Sciences. Based on domestic research and teaching bases, the applicant is conducting innovative research on the monitoring, early warning, and prevention technology system for sudden and new respiratory infectious diseases. The applicant will further improve the construction of the college's academic system, strengthen the interdisciplinary integration model of "group medicine+", effectively promote the development of disciplines, cultivate a group of high-level scientific research talents who can play a decisive role in responding to public health emergencies, and make positive contributions to the construction of "Double First Class" disciplines and high-level public health colleges in the School of Group Medicine and Public Health.

XiaoYou Su

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Educational Background

2005-2010	PhD	**Social Medicine, The Chinese University of Hong Kong, Hong Kong, China**
1995-1998	Master	**Environmental Health, Shandong Medical University, Shandong, China**
1990-1995	Bachelor	**Preventive Medicine, Shandong Medical University, Shandong, China**

Professional Experience

2020.7-present	**Professor,** Department of Global Health, School of Population Medicine and Public Health, Peking Union Medical College
2016.4-2020.7	**Associate Professor,** Department of Epidemiology and Statistics, School of Public Health, Peking Union Medical College
2016.4-2017.12	**Research Associate,** Department of Epidemiology and Biostatistics, University of California, San Francisco
2012.7-2016.4	**Project Officer,** Department of International Cooperation, Chinese Academy of Medical Sciences & Peking Union Medical College
2005.6-2009.9	**Research Coordinator,** Department of Epidemiology and Statistics, School of Public Health and Primary Care, The Chinese University of Hong Kong
2009.11-2010.12	**Research Coordinator,** Department of Surgery, The Chinese University of Hong Kong
2005.6-2009.11	**Research Coordinator,** Department of Epidemiology and Statistics, School of Public Health and Primary Care, The Chinese University of Hong Kong
2003.11-2005.7	**AIDS Program Officer,** CIPRA Program (sponsored by NIH), China CDC
2000.8-2001.8	**Research Fellow,** Muhimbili National Hospital, Tanzania
1998.9-2003.11	**Research Fellow-AIDS Department,** China Academy of Traditional Medicine

TEACHING

Postgraduate Program in **Global Health Essentials**, course convener, School of Public Health and School of Population Medicine and Public Health, Peking Union Medical College, 2014-present. The

course was rated as one of the top-quality postgraduate courses of PUMC in 2022

Postgraduate Program in **Introduction to Diplomacy**, course convener, School of Population Medicine and Public Health, Peking Union Medical College, 2021-present

Postgraduate Program in **Global Health Security**, School of Population Medicine and Public Health, Peking Union Medical College, 2021-present

Postgraduate Program in **Ethics of Public Health**, School of Population Medicine and Public Health, Peking Union Medical College, 2023-present

Undergraduate Program in **Social Medicine,** School of Nursing, Peking Union Medical College, 2021-present

Postgraduate Program in **Epidemiology and Biostatistics**, School of Public Health and Primary Care, Chinese University of Hong Kong, Hong Kong, 2009 – 2010

Supervision of 11 graduate students currently, **Outstanding Teacher** of Peking Union Medical College in 2023

GRANTS

Social environment survey among people living with HIV in China, sponsored by UNAIDS, ongoing

Technical and strategic study on eradication of cervical cancer in China, sponsored by Chinese Academy of Medical Sciences, ongoing

EEG and mental health screening among various population, sponsored by BrainCo, ongoing

School Bullying and mental health among boarding school students in China, sponsored by National Center for Mental Health, China, ongoing

SOCIAL SERVICES

Member, Global Health Branch, Chinese Preventive Medicine Association

Member, Cancer Prevention and Control Branch, Chinese Preventive Medicine Association

Member, Chinese Association for Student Nutrition & Health Promotion

Member, International Medical Services Branch, Chinese Hospital Association

Member, Mental Health Branch, National Health and Promotion Expert Database

Member, Chronic Diseases Branch, National Terminology Committee of Public Health and Preventive Medicine

BOOKS

Chen Wang, **Xiaoyou Su**, Hongchi Wei. ***The Oxford Handbook of Global Health Politics.*** Peking Union Medical College Press, 2024, ISBN 9787567922075 (Chief Translator)

Chen Wang, Weizhong Yang. ***Population Medicine.*** Peking Union Medical College Press, 2022, ISBN 9787567915503 (Translator)

Chen Wang, Weizhong Yang. ***How to practise Population Medicine.*** Peking Union Medical College Press, 2022, ISBN 9787567919136 (Translator)

Xiaohui Liang, Zongfu Mao. ***Global Health Case Studies.*** China Science Publishing & Median LTD. 2019, ISBN 9787030597847 (Editor)

Minghui Ren, Shenglan Tang, Yuanli Liu. ***An Introduction to Global Health.*** People's Medical

Publishing House Co. LTD, 2016, ISBN 9787117220606 (Editor)

SELECTED PUBLICATIONS

1. Liu X, Wu YJ, **Su XY§**, et al. COVID-19 Vaccine Hesitancy Among People Living with HIV: A Systematic Review and Meta-Analysis. ***AIDS and Behavior***. 2024.
2. Dai ZW, Wu YJ, **Su XY§**, et al. Characteristics and Influencing Factors of Anticipated HIV Stigma among HIV-negative/unknown MSM in China: a Regression Mixture Model. ***Brain and Behavior*** 2024;14(4):e3472.
3. Wu YJ, Dai ZW, **Su XY§**, et al. Prevalence and influencing factors of PTSD symptoms among healthcare workers: A multicenter cross-sectional study during the surge period of the COVID-19 pandemic since December 2022 in the Chinese mainland. ***Journal of Affective Disorders*** 2024;348:70-77.
4. Xiao WJ, Liu XY, **Su XY§**, et al. Prevalence and risk for symptoms of PTSD among survivors of a COVID-19 infection. ***Psychiatry Research*** 2023;326:115304.
5. Huang YM, Zhang L, **Su XY§**, et al. COVID-19 Vaccine Hesitancy Among Patients Recovered From COVID-19 Infection in Wuhan, China: Cross-Sectional Questionnaire Study. ***JMIR Public Health and Surveillance*** 2023;9:e42958.
6. Zhang L, Wu YJ, **Su XY§**, et al. The second dose of COVID-19 vaccine booster hesitancy among health care workers in China: A multicenter cross-sectional study. ***American Journal of Infection Control*** 2023;52(5):525-532.
7. Chen X, Dai ZW, **Su XY§**, et al. Suicidal ideation and associated risk factors among COVID-19 patients who recovered from the first wave of the pandemic in Wuhan, China. ***Qjm-an International Journal of Medicine*** 2023***;***hcad083.
8. Dai ZW, Si MY, **Su XY§**, et al. Depressive symptoms, perceived social support, and anticipated HIV stigma among HIV-negative/unknown men who have sex with men in China during the COVID-19 pandemic: A multicenter online cross-sectional study. ***Brain and Behavior*** 2023;13(4):e2946.
9. Jing S, **Su XY§**, Wang C et al. Prevalence and influencing factors of depressive and anxiety symptoms among hospital-based healthcare workers during the surge period of the COVID-19 pandemic in the Chinese mainland: a multicenter cross-sectional study. ***QJM-An International Journal of Medicine*** 2023;116(11):911-922.
10. Fu JQ, Chen X, **Su XY§**, et al. HIV-related stigma, depression and suicidal ideation among HIV-positive MSM in China: a moderated mediation model. ***BMC Public Health*** 2023;23(1):2117.
11. Liu XY, Xiao WJ, **Su XY§**, et al. Prevalence and influencing factors of PTSD symptoms among the general population during the surge period of COVID-19 pandemic in mainland China. ***General Hospital Psychiatry*** 2023.
12. Xiao WJ, Liu XY, **Su XY§**, et al. Mediating role of resilience in the relationship between COVID-19 related stigma and mental health among COVID-19 survivors: a cross-sectional study. ***Infectious Diseases of Poverty*** 2023;12(1):27.
13. Dai ZW, Si MY, **Su XY§**, et al. Willingness to human papillomavirus (HPV) vaccination and influencing factors among male and female university students in China. ***Journal of medical virology*** 2022;94:2776-2786.

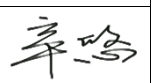
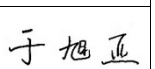
9. Team Capability

- ***Narrative Description of Project Team***

This project will be executed by a multidisciplinary team including public health, epidemiology, IT, and clinical medicine. This project is proposed by Dr. Ye Wang, who is a young and vigorous investigator in PUMC. He gained a PhD degree in epidemiology in 2021 and has been engaging in respiratory diseases for the past four years. The project is co-supervised by Prof. Zhongjie Li, who is an outstanding practitioner in disease control and public health. We also work with Yichang CDC, which provides the field for this project. The AI-assisted CXR system will be provided by JF Healthcare Co., Ltd. The project team is also composed of staff from the CDC, primary healthcare institutions, and students.

- ***Information of Key Members***

	Name	Age	Highest Degree	Institution	Professional Title	Specialty	Role and Responsibility in the Project	% of Work Time on this Project	Signature
PI	Ye Wang	31	Doctoral degree	PUMC	Assistant Professor	Epidemiology	Conceptualize the study, fieldwork, data analysis, and report	50%	
Co-PI	Wei Liu	46	Doctoral degree	JF Healthcare Co.Ltd	Chief Medical Officer	Pathogenic Microbiology	Conceptualize the study, fieldwork, data analysis, and report	40%	
Co-PI	Zhongjie Li	47	Doctoral degree	PUMC	Professor	Infectious Diseases Control	Conceptualize the study, fieldwork, data analysis, and report	40%	
Co-PI	Xiaoyou Su	50	Doctoral degree	PUMC	Professor	Social Medicine	Conceptualize the study, fieldwork, data analysis, and report	40%	
Senior Consultant	Wenbiao Hu	60	Doctoral degree	The University of Queensland	Professor	Infectious Diseases	Study design and consulting	10%	
Senior Consultant	Xiaolin Wei	50	Doctoral degree	University of Toronto	Professor	Implementation Science	Study design and consulting	10%	

Team member	Jianhua Liu	42	Doctoral degree	Yi Chang CDC	Professor	Disease Control	Fieldwork, data analysis, and report	30%	
Team member	Li Zhang	34	Doctoral degree	PUMC	Assistant Professor	Epidemiology	Fieldwork, data analysis, and report	30%	
Team member	Jian Li	41	Doctoral degree	JF Healthcare Co.Ltd	—	Artificial Intelligence	Fieldwork, data analysis, and report	30%	
Team member	Zhengwei Dai	25	Master's degree	Peking University Sixth Hospital	—	Public Health	Fieldwork, data analysis, and report	20%	
Team member	You Xin	23	Bachelor degree	PUMC	—	Public Health	Fieldwork, data analysis, and report	20%	
Team member	Wenjie Jiang	23	Bachelor degree	PUMC	—	Public Health	Fieldwork, data analysis, and report	20%	
Team member	Xuya Yu	32	Master's degree	PUMC	—	Public Health	Fieldwork, data analysis, and report	20%	
Team member	Ling Xin	23	Bachelor degree	PUMC	—	Population Medicine	Fieldwork, data analysis, and report	20%