Digital Risk-stratification Management Platform Enhances HCC Screening Efficiency in High-risk Populations: a Regional Screening Program in China

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BACKGROUND

Liver cancer represents a significant health burden in China. According to recent data from the National Cancer Center, in 2022, China reported 367,700 new cases of liver cancer and 316,500 deaths, constituting 42.5% and 41.4% of the global totals[1,2], respectively. Among these, 85%-90% are hepatocellular carcinoma (HCC). The five-year survival rate for HCC patients in China remains critically low at 14.4%[3], starkly contrasting Japan's 58%[4] and US'22%[5], primarily due to late-stage diagnosis. The early diagnosis rate is below 20%[6], which is significantly lower than in the United States and Asia-Pacific regions[5,7]. Therefore, implementing and enhancing risk-stratified screening is essential to improving survival rates and reducing the disease burden. To address this gap, the Center for Disease Control and Prevention (CDC) of Shanghai Jiading District initiated a risk-stratification HCC screening project (Key Discipline Project of Infectious Disease Epidemiology for High-Quality Development of Public Health, GWGZLXK-2023-01)* together with Roche Diagnostics Shanghai Limited., to aid in the early screening in a real-world setting.

METHODS

This district-wide HCC screening project, utilizing the Liver Disease Pathway (LDP) digital platform integrated 13 community health service centers, 1 tier 3 hospital, a district healthcare administration and the local CDC. The LDP platform facilitates standardized, unified, and data-driven screening procedures, incorporating functionalities for participant management, result uploads, risk assessment, report generation, and patient follow-up management. This innovative approach leverages big data analysis to identify high-risk individuals (aged 40-74 with chronic hepatitis B/C, cirrhosis, etc.) and offers one-stop screening services, including blood tests, abdominal ultrasound, and physical examinations. Additionally, multiple predictive models such as aMAP, THRI, mPAGE-B, and CAMD are utilized to generate personalized risk situation evaluation reports (low, medium, high, and very high risk for developing), therefore based on stratified follow-up management to ensure timely monitoring and efficient allocation of healthcare resources.

The early diagnose rate (defined as CNLC Ia-IIa) was calculated and compared to the national benchmark. The health economic evaluation of this real-world screening project was also analyzed through the published cost-effectiveness analysis (CEA) model[8], and the incremental cost-effectiveness ratio (ICER) would then be compared with the per capita Gross Domestic Product (GDP) of 2024.

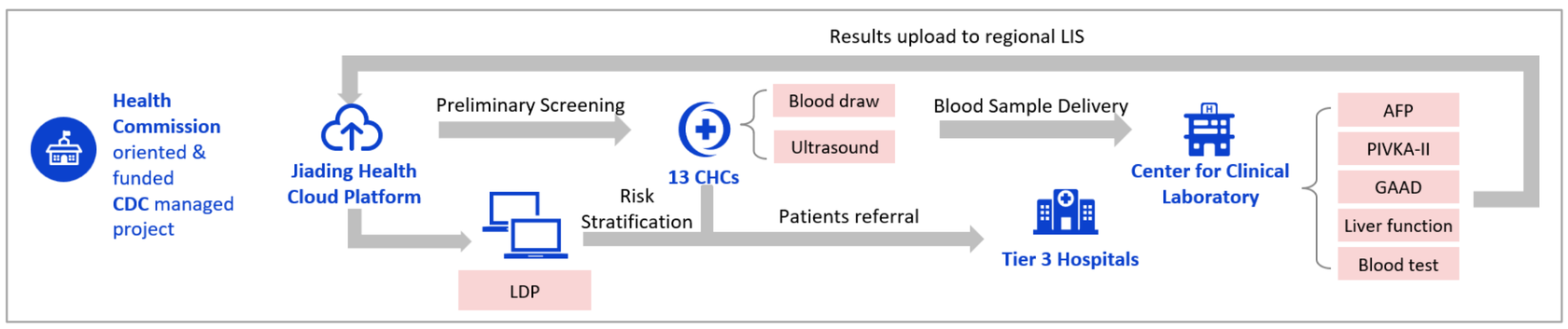

Figure.1 Implementation Pathway of Jiading HCC Screening Program

RESULTS

By January 2025, 12,230 individuals have been included, with an average of 62. All participants underwent screening, identifying 1,230 abnormal findings requiring further evaluation and confirming 16 HCC cases (12 were at early stages). The proportions of patients with different risks were: low risk (2,719, 22.6%), medium risk (6,785, 56.5%), high risk (2,298, 19.1%), and very high risk (211, 1.8%). The early diagnose rate was 75.0%, which was much higher than the national average (17.5% - 20.3%)[9-10]. Compared to the no-screening group, the screening group demonstrated significant health economic advantages, with an ICER of ¥20,234/QALY, which was far below per capita Gross Domestic Product (¥95,749)[11] . Further analysis showed that the increase in the starting age for screening would lead to reduced survival benefits, including live year (LY) and QALY.

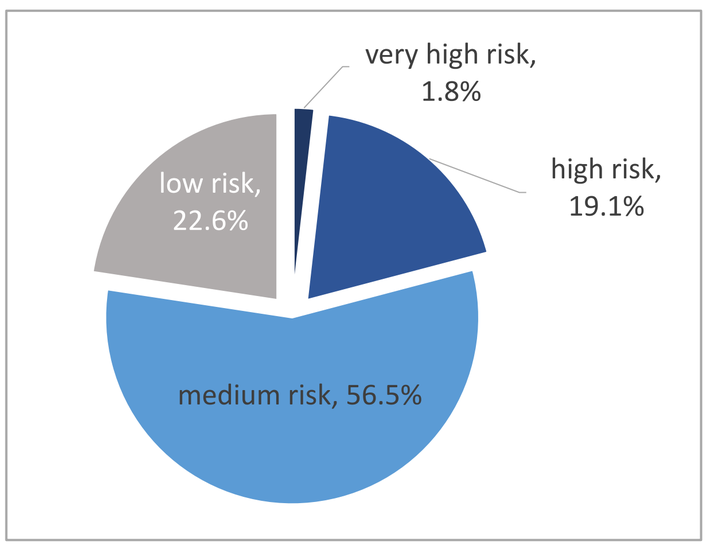

Figure 2: Risk Stratification Results

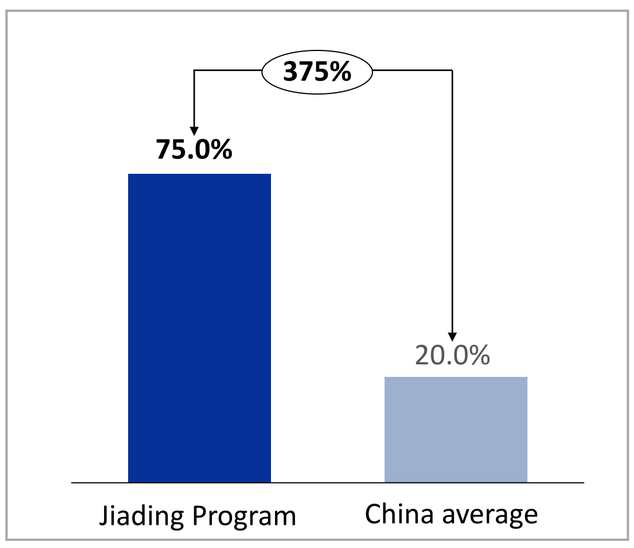

Figure 3: HCC early-diagnose rate

Table 1: health economic result

	Screening group	No-screening group	Difference
Total LY	10.40	9.25	1.14
Total QALY	8.98	8.04	0.94
Total Cost	¥79,351	¥60,310	¥19,041
ICER			**¥20,234**

CONCLUSION

The Jiading District's innovative project demonstrates that the digital risk-stratification system can improve early diagnose rate, optimize HCC screening efficiency, and enhance resource allocation in China. The community engagement efforts significantly improved both screening participation and HCC awareness among the target population. This standardized, risk-stratified approach offers a scalable model for nationwide implementation, especially for individuals among 40-50 years old, demonstrating cost-effectiveness and long-term healthcare expenditures savings.

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Abbreviation
- CDC: Center of Disease Prevention and Control
- LDP: Liver Disease Pathway
- CHC: Community Health Center
- AFP: Alpha-Fetoprotein
- PIVKA-II: Protein Induced by Vitamin K Absence or Antagonist-II or DCP, Des-γ-Carboxy Prothrombin

Note:
- *Peisong Zhong and Fanglan Yin are co-first authors with equal contribution
- *This Jiading Program is selected as High-Quality Development Project

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