



Zero-Miss Lung Nodule Triage: A Knowledge-Based AI Empowering Primary Care in Resource-Limited Settings

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INTRODUCTION

In mainland China, the high accessibility and remarkably low out-of-pocket cost of chest computed tomography (CT) scans (USD \$26) have facilitated widespread screening, resulting in a substantial increase in the detection of incidental pulmonary nodules (IPNs). However, a severe shortage of thoracic specialists and insufficient specialized training among primary care physicians has created a critical bottleneck. Consequently, many patients with high-risk nodules identified across multiple CT reports fail to receive timely clinical interventions. This systemic gap disproportionately affects resource-limited regions, where the scarcity of specialists frequently delays potentially life-saving care. To address this challenge, we developed a highly lightweight artificial intelligence (AI) tool capable of interpreting CT text reports to assist primary care triage, explicitly eliminating the need for large-scale DICOM image data transfers.

METHODS

We developed an ultra-fast, text-based AI diagnostic tool employing a knowledge-based architecture that integrates explicit medical prior rules with the semantic reasoning capabilities of a Large Language Model (Qwen3-235B). This knowledge-driven strategy substantially reduced the reliance on large datasets, enabling robust model construction and training using a highly curated cohort of only 500 annotated reports. The algorithm applies a stringent “hit-and-stop” sequential judgment mechanism to directly extract and interpret radiographic terminology from text for IPN risk stratification. The tool’s clinical reliability and generalizability were subsequently validated using a large, independent, real-world cohort comprising 3,599 cases.

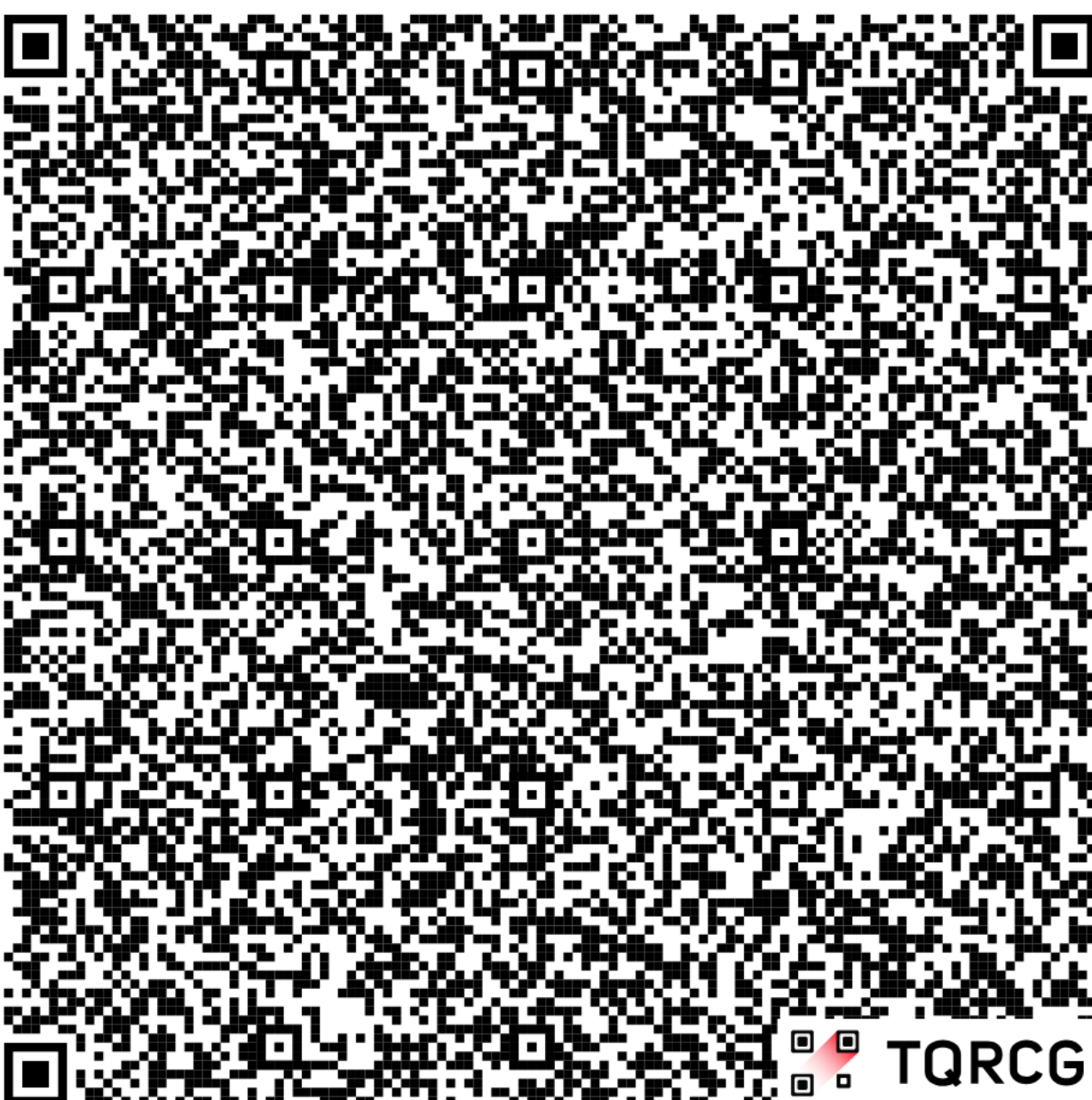
DISCUSSION AND CONCLUSION

This knowledge-based AI tool offers a highly accurate, ultra-fast solution for IPN risk stratification requiring minimal training data. By completely eliminating false negatives and avoiding complex DICOM transmissions, it holds substantial significance for resource-limited settings. It empowers primary care physicians to make rapid, reliable referral decisions, effectively mitigating specialist shortages and preventing critical delays in the management of high-risk lung nodule patients.

REFERENCES & ACKNOWLEDGEMENTS

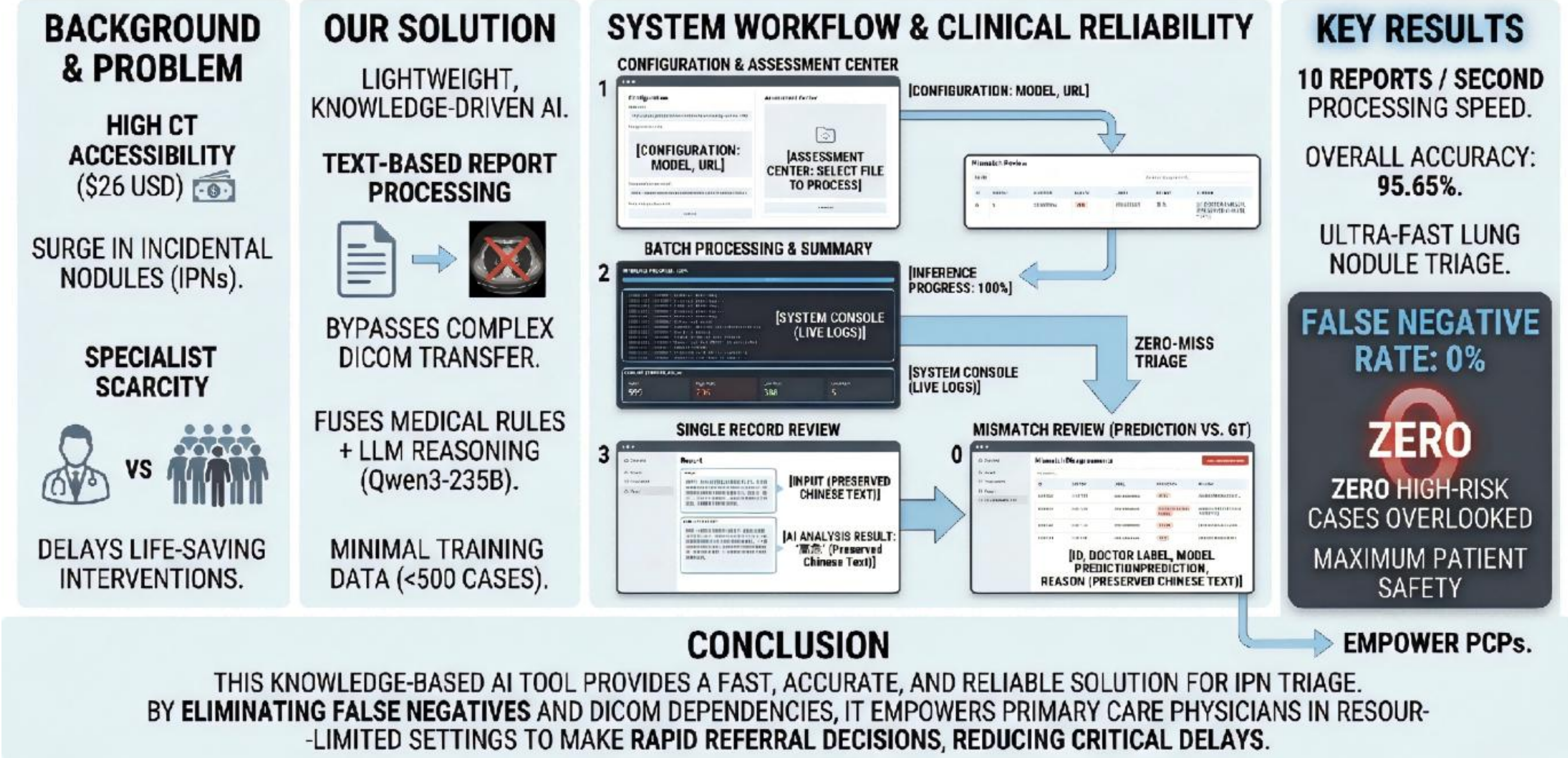
Artificial Intelligence (AI) Use Disclaimer

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RESULTS

By bypassing DICOM image analysis and adopting report-based processing, the AI tool demonstrated exceptional computational efficiency, achieving a processing rate of 10 reports per second. In the large-scale validation cohort (n = 3,599), the tool attained an overall diagnostic accuracy of 95.65%. The system successfully stratified the cohort into 1,206 high-risk, 2,388 low-risk, and 5 indeterminate cases. Most importantly, the model achieved a false-negative rate of 0%. This zero-miss rate ensures that no high-risk patients are overlooked or erroneously classified as low-risk, thereby guaranteeing maximal patient safety.



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