Ethics, Medicine and Public Health 33 (2025) 101025

Contents lists available at ScienceDirect

Ethics, Medicine and Public Health

journal homepage: www.sciencedirect.com/journal/ethics-medicine-and-public-health

Letter to the Editor

A retrospective cohort study on lung cancer screening methods in Japan and the US

Dear Editor,

This paper analyzes lung cancer screening effectiveness in Japan and the US from 1998 to 2021, focusing on sensitivity, specificity, and accuracy. Despite technological advances, results show varying performance across different methods. In Japan, a 1998-2002 study revealed high specificity for chest X-ray (97.0%) and good sensitivity for low-dose CT (88.9%). A 2013–2021 study using a novel fluorescent probe showed high sensitivity (96.3%) and specificity (85.2%) in surgical specimens. US studies demonstrated high sensitivity but lower specificity for low-dose CT (2002–2004), while a biomarker-based classifier (2010–2019) achieved 90% accuracy. These findings suggest room for improvement in balancing sensitivity and specificity across different screening methods in both countries.

Toyoda et al. reported that a study on lung cancer screening in Japan was conducted from August 1998 to May 2002, comparing two screening methods: low-dose CT and chest X-ray [1]. For low-dose CT screening, which involved 7183 tests, the sensitivity was 88.9% using the detection method and 79.5% using the incidence method, with a specificity of 92.6%. The accuracy of low-dose CT screening using the detection method was 90.75%. In contrast, chest X-ray screening, which encompassed a larger sample of 36,085 tests, demonstrated a sensitivity of 78.3% using the detection method and 86.5% using the incidence method, with a higher specificity of 97.0%. The accuracy of chest X-ray screening using the detection method was slightly lower at 87.65%. These results provided a comprehensive comparison of the two screening methods for lung cancer detection in Japan during the specified time period, with chest X-ray screenings being conducted more than five times as frequently as low-dose CT screenings [1].

Kawashima et al. conducted a study in Japan focusing on lung cancer detection using a novel fluorescent probe, glutamine-alanine-2-methyl silicon rhodamine (QA-2MeSiR), in surgical specimens [2]. Their research, involving patients who underwent lung cancer surgery between 2013 and 2021, aimed to evaluate this imaging technique's effectiveness. The development process involved screening 400 red fluorescent probes based on the 2MeSiR scaffold before selecting QA-2MeSiR for the study. The selected fluorescent probe demonstrated impressive results, with a sensitivity of 96.3% and a specificity of 85.2% for visualizing lung cancer in surgical specimens within a rapid 10-minute timeframe. These metrics were determined by comparing the imaging results to the gold standard of pathological assessment of the specimens. The overall accuracy of this method was calculated to be 90.75%, indicating a high level of reliability in detecting lung cancer. Their study highlighted the potential of fluorescent probe technology as a quick and accurate tool for identifying cancerous tissue during surgical procedures for lung cancer in Japan, and underscores the extensive screening process involved in developing effective imaging agents.

A comparative study on lung cancer screening methods was conducted from August 2002 through April 2004, involving 53,439 US participants [3]. Their study evaluated low-dose CT screening and chest radiography (X-ray) effectiveness. Low-dose CT demonstrated high sensitivity (93.8%) but lower specificity (73.4%), while chest X-ray showed lower sensitivity (73.5%) but higher specificity (91.3%). Interestingly, chest X-ray outperformed low-dose CT in overall accuracy (91.1% vs. 73.6%). These findings highlighted the trade-offs between sensitivity and specificity in lung cancer screening methods. The large sample size provides robust data for assessing screening efficacy during a period of significant lung cancer incidence in the US. Their study underscored the importance of considering multiple factors when evaluating screening effectiveness [3].

Goebel et al. conducted a comprehensive U.S. lung cancer study from 2010 to 2019, analyzing 1479 plasma samples, including 351 Non-Small Cell Lung Cancer (NSCLC) cases [4]. The research utilized a robust methodology, involving 554 subjects in the training set and 925 in the validation set. A sophisticated classifier employing 33 biomarkers demonstrated impressive results, achieving 90% accuracy, 80% sensitivity, and 95% specificity in validation. The study's reliability was further confirmed by the ROC curve analysis, which showed an AUC of 0.963, improving to 0.974 when excluding non-NSCLC cancers. Notably, significant biomarker upregulations were observed in NSCLC patients, enhancing the diagnostic potential. The study's strength lies in its diverse cohort, encompassing a wide age range (25–94 years) and combining low-dose CT with standard chest X-ray screening methods. This integrative approach yielded substantial clinical benefits, demonstrating a 20% reduction in mortality compared to chest X-ray alone, underscoring the potential of multi-modal screening strategies in improving lung cancer detection and patient outcomes.

The reviewed studies provide valuable insights into the efficacy of various lung cancer screening and detection methods in Japan and the United States. Low-dose CT consistently demonstrated high sensitivity but lower specificity compared to chest X-ray in both countries, though with some variations in performance. The novel fluorescent probe technique introduced in Japan and the biomarker-based classifier developed in the US offer promising advancements in detection methods.

These findings underscore the critical importance of a multifaceted approach when evaluating screening effectiveness, encompassing not only sensitivity, specificity, and accuracy but also practical implementation considerations and long-term patient outcomes. The observed differences between Japan and the US highlight the complex interplay of population characteristics, healthcare system structures, and technological advancements in shaping screening outcomes. Moreover, these variations emphasize the need for tailored screening strategies that account for regional differences in disease prevalence, risk factors, and available resources. Tables 1 and 2 provide a comprehensive summary

https://doi.org/10.1016/j.jemep.2024.101025

Table 1
Lung cancer screening with CT, X-ray and QA-2MeSir in Japan.

Confusion	Year	
	1998–2002 [1]	2013–2021 [2]
Sensitivity	88.9% (Low-dose CT) 78.3% (Chest X-ray)	96.3% (QA-2MeSiR)
Specificity	92.6% (Low-dose CT) 97.0% (Chest X-ray)	85.2% (QA-2MeSiR)
Accuracy	90.75% (Low-dose CT) 87.65% (Chest X-ray)	90.75% (QA-2MeSiR)

Table 2
Lung cancer screening with CT, X-ray, and CT + X-ray in the US.

Confusion	Year	
	2002–2004 [3]	2010–2019 [4] CT + X-ray for NSCLC
Sensitivity	93.8% (low-dose CT) 73.5% (X-ray)	80%
Specificity	73.4% (low-dose CT) 91.3% (X-ray)	95%
Accuracy	75.5% (low-dose CT) 91.1% (X-ray)	90%

of the confusion matrix results, offering a quantitative basis for comparing the performance of various screening methods across different populations and time periods. This comparative analysis serves as a valuable tool for policymakers and healthcare professionals in optimizing lung cancer screening programs and allocating resources effectively to maximize early detection rates and minimize false positives.

Future research should focus on refining existing techniques, exploring innovative detection methods, and developing integrated screening approaches tailored to each country's specific needs and resources. Cross-cultural studies and knowledge exchange between Japan and the US could further enhance lung cancer detection strategies and ultimately improve patient outcomes in both nations.

Authors' contributions

WenKang Huang investigated, WenKang Huang and Yoshiyasu Takefuji wrote this article.

Consent to participate

Not applicable.

Consent for publication

Not applicable.

Funding

This research has no fund.

Conflicts of interest

The author has no conflict of interest.

Ethics approval

Not applicable.

Availability of data and material

Not applicable.

Code availability

Not applicable.

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