

Use of Nanotechnology and Artificial Intelligence to Improve Predictive Lung Cancer Detection in People Over 60 Years of Age A Systematic Literature Mapping

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ABSTRACT

Context: Lung cancer represents a major global health challenge, with early detection being crucial for improving treatment and patient outcomes, especially among those over 60 years of age. Emerging technologies such as nanotechnology and artificial intelligence offer promising approaches to improve diagnostic capabilities and prognostic accuracy.

Objectives: This systematic literature mapping aims to comprehensively review existing research on the integration of nanotechnology and artificial intelligence in the early detection of lung cancer in elderly populations. It seeks to identify trends, gaps, and advances in this interdisciplinary field, exploring both the opportunities and challenges these technologies present.

Methods: A systematic search was conducted in major electronic databases, applying predefined inclusion and exclusion criteria. Selected studies were critically appraised for their contribution to the use of nanotechnology and artificial intelligence in lung cancer diagnosis. Finally, they are validated against the research questions.

Results: The study highlighted the growing use of nanotechnology and artificial intelligence in lung cancer detection, including techniques for detecting sensitive biomarkers and enhancing images. Artificial intelligence algorithms were also used for predictive modeling and clinical decision support, reflecting the ongoing evolution of research in this dynamic field.

Conclusions: The innovative potential of combining nanotechnology and artificial intelligence for detecting lung cancer in older adults is highlighted. Future research will seek to expand these applications to other types of cancer and explore new technologies to improve diagnostic accuracy and clinical outcomes, driving the need for innovation in the medical field.

Keywords: Nanotechnology, Artificial Intelligence, Lung Cancer

Background

In we see background and references as a starting point for this study, which provided support and guidelines for the proposed innovation, from the perspective of lung cancer image analysis using artificial intelligence [1,2].

From the nanotechnology perspective, there are various studies that recognize lung cancer as a pathology that can be understood and analyzed from a micro and nanometric perspective. This allows for innovative strategies and diagnostics for early

diagnosis, allowing for more precise individualization of the components and drugs needed for early detection, and thus enabling appropriate therapies for treatment that contributes to a good quality of life. There are studies and proposals for solutions from the perspective of data refinement to detect respiratory cancer through diagnostic imaging [3,4]. This allows for an improved degree of prediction, without encompassing broader fields for other types of studies [5].

Research Questions

We begin the mapping in question by posing the research questions. These guide the methodology of the systematic review, a mapping type in this case. The idea is to focus research

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through reviews from the perspective of literature mapping in such a way as to encompass the studies carried out to emphasize the value, relevance, and contribution of the underlying research in helping to improve health outcomes for older populations.

Research Questions	Motivation
Q1. What are the current studies related to the detection of lung cancer in older adults using nanotechnology and artificial intelligence?	M1. Nanotechnology provides methods and tools to improve the accuracy and sensitivity of detection by enabling the identification of specific biomarkers at the molecular level. Artificial intelligence provides the ability to draw conclusions and provide predictive information. Understanding the current studies that demonstrate these capabilities is crucial for detecting cancer at an early stage.
Q2. Which AI algorithms show promise in analyzing complex datasets from lung cancer screening to improve predictive accuracy in older populations?	M2. AI algorithms can process large amounts of images and patient data quickly and accurately. Identifying the most effective algorithms for analyzing lung cancer markers specific to older adults could lead to more accurate predictive models.
Q3. What are the potential risks associated with the deployment of artificial intelligence and nanotechnology in lung cancer screening in older populations?	M3. The incorporation of advanced technologies into healthcare raises ethical concerns regarding privacy, informed consent, and equity of access. Addressing these considerations ensures responsible implementation and appropriate adoption of new diagnostic approaches.
Q4. What are the long-term effects of early detection facilitated by nanotechnology and artificial intelligence on the overall survival rates and quality of life of older people diagnosed with lung cancer?	M4. Beyond detection, the ultimate goal is to improve patient outcomes and quality of life. Longitudinal studies examining survival rates, treatment outcomes, and patient reports will assess the true impact of these technologies on clinical practice.
Q5. What are the appropriate criteria and standards for evaluating the performance and clinical utility of nanotechnology- and artificial intelligence-based tools in the prediction and diagnosis of lung cancer in older populations?	M5. It is essential to establish robust metrics to assess the accuracy, sensitivity, specificity, and clinical impact of new diagnostic technologies. Defining benchmarks will enable comparison with existing methods and facilitate evidence-based decisionmaking regarding the adoption and implementation of these innovative tools in clinical practice.

Review Methods

A study was conducted using the Systematic Literature Mapping methodology, designed to conduct a comprehensive exploration of information in scientific articles focused on specific topics. Initially, a relevant research problem was identified as the central focus of the inquiry. This problem was then addressed systematically, grounded in the current literature, thereby defining the scope of the research and integrating various elements to answer specific research questions. Conclusions were derived from the findings obtained at the end of the search process.

Sources: ACM Digital Library, IEEE Explore, ScienceDirect, Google scholar.

Studies included and excluded

To ensure relevant and accurate results when searching for articles on automated code generation or refactoring using Artificial Intelligence, strict inclusion and exclusion criteria have been established:

Inclusion Criteria

- Articles in English and Spanish.
- Published between 2020 and 2024.
- From scientific conferences or journals.
- Related to the use of nanotechnology, artificial intelligence in the healthcare field, and lung cancer detection in people over 60 years of age.

Exclusion Criteria

- Articles that address tangential or not directly related topics.
- Studies that do not use nanotechnology, are not applied to tumor pathology, or employ Artificial Intelligence methods.
- Publications prior to 2020, with the aim of focusing on recent advances.

Applying these criteria guarantees the selection of a select set of relevant and reliable articles, essential for research into automated code generation or refactoring using Artificial Intelligence. This selection allows researchers to focus on the most recent and highest-impact studies in this expanding field.

Results

After applying and adjusting search strings, the search was filtered using the inclusion and exclusion criteria. The initial objective was reviewed and validated with the research questions to identify the primary articles truly relevant to this review. The search started with 408 articles, and after adjusting the string, the search was reduced to 61. The search was then refined over time by applying the inclusion and exclusion criteria, ultimately verifying the search string and arriving at approximately 20 primary references.

This systematic mapping of the literature on the integration of nanotechnology and artificial intelligence (AI) to improve predictive lung cancer detection in people over 60 years of age revealed the following:

The studies highlighted advances in nanotechnology, such as nanosensors and nanoparticle imaging, which improve sensitivity and specificity in the detection of cancer biomarkers [5].

AI algorithms integrated with nanotechnology have improved diagnostic accuracy by predicting lung cancer malignancy and facilitating personalized treatments [6,7].

Discussions in the literature highlighted clinical benefits such as early intervention, although challenges in protocol standardization and ethical considerations were also identified, as detailed in the next section.

Discussions

Studies such as those by demonstrate how advanced nanosensors can detect specific biomarkers with exceptional accuracy, enabling timely interventions [7]. Furthermore, the integration of AI algorithms with these nanotechnological advances shows promising results in increasing diagnostic accuracy. Research, such as that conducted by shows how machine learning models, combined with high-resolution nanoparticle-enabled imaging, accurately predict the malignancy of lung lesions, supporting more informed clinical decisions tailored to individual patient profiles [2].

However, addressing current challenges in protocol standardization and ensuring systems interoperability, as highlighted in the discussions by remains critical to maintaining the reliability and reproducibility of findings in clinical practice [8]. Furthermore, ethical considerations and regulatory frameworks must be rigorously evaluated and navigated to maintain patient safety and equitable access to these advanced oncology technologies for older adults.

Conclusions

This mapping explored how nanotechnology and artificial intelligence (AI) are being used to improve predictive lung cancer detection in adults over 60 years of age [9]. Nanotechnology was found to offer advanced methods for early cancer detection through highly sensitive biosensors and imaging techniques [10].

The integration of AI algorithms with nanotechnology enables more precise processing of complex data, thereby improving diagnostic accuracy and facilitating personalized treatments [5]. The need for interdisciplinary collaboration to effectively translate these technological advances into clinical practice is highlighted. Despite these advances, challenges such as protocol standardization and ethical considerations remain, which must be addressed to optimize these innovations in oncology for older adults [11].

It is recommended to delve deeper into other pathologies and organs based on the results of this review. We also consider it important to observe and stay up-to-date with any advances that may occur in either nanotechnology or artificial intelligence algorithms, with the aim of improving the response quality of the models and markers.

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