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Artificial Intelligence in Cancer Diagnosis

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ABSTRACT

Artificial intelligence has aided in the advancement of healthcare research. The availability of open-source healthcare statistics has prompted researchers to create applications that aid cancer detection and prognosis. Deep learning and machine learning models provide a reliable, rapid, and effective solution to deal with such challenging diseases in these circumstances. PRISMA guidelines had been used to select the articles published on the web of science, EBSCO, and EMBASE between 2009 and 2021. In this study, we performed an efficient search and included the research articles that employed AI-based learning approaches for cancer prediction. A total of 185 papers are considered impactful for cancer prediction using conventional machine and deep learning-based classifications. In addition, the survey also deliberated the work done by the different researchers and highlighted the limitations of the existing literature, and performed the comparison using various parameters such as prediction rate, accuracy, sensitivity, specificity, dice score, detection rate, area undercover, precision, recall, and F1-score. Five investigations have been designed, and solutions to those were explored. Although multiple techniques recommended in the literature have achieved great prediction results, still cancer mortality has not been reduced. Thus, more extensive research to deal with the challenges in the area of cancer prediction is required.

Index Terms **- Omics, Cancer, Screening, Artificial Intelligence, Deep Learning, Precision Medicine, Early Diagnosis**

INTRODUCTION

Early cancer diagnosis and artificial intelligence (AI) are rapidly evolving fields with important areas of convergence. In the United Kingdom, national registry data suggest that cancer stage is closely correlated with 1-year cancer mortality, with incremental declines in outcome per stage increase for some subtypes. Using lung cancer as an example, 5-year survival rates following resection of stage I disease are in the range of 70–90%; however, rates overall are currently 19% for women and 13.8% for men. In 2018, the proportion of patients diagnosed with early-stage (I or II) cancer in England was 44.3%, with proportions lower than 30%. National Health Service (NHS) long-term plan. Internationally, early diagnosis is recognised as a key priority by a number of organisations, including the World Health Organisation (WHO) and the International Alliance for Cancer Early Detection (ACED). Many studies indicate that screening can improve early cancer detection and mortality, but even in disease groups with established screening programmes such as breast cancer, there are ongoing debates surrounding patient selection and risk–benefit trade-offs, and concerns have been raised about a perceived 'one size fits all' approach incongruous with the aims of personalised medicine. Patient selection and risk stratification are key challenges for screening programmes. AI algorithms, which can process vast amounts of multi-modal data to identify otherwise difficult-to-detect signals, may have a role in improving this process in the near future. Moreover, AI has the potential to directly facilitate cancer diagnosis by triggering investigation or referral in screened individuals according to clinical parameters, and automating clinical workflows where capacity is limited. In this review, we discuss the potential applications of AI for early cancer diagnosis in symptomatic and asymptomatic patients, focussing on the types of data that can be used and the clinical areas most likely to see impacts in the near future.

OBJECTIVES

1. Image Analysis: AI algorithms can analyze medical images like CT scans, mammograms, and pathology slides. They can identify subtle changes or abnormalities that might be difficult for the human eye to detect.

2. Early Detection: AI can aid in early cancer detection by identifying precancerous lesions or tumors at an early stage, improving the chances of successful treatment.

3. Tumor Classification: It can classify different types of tumors, which is crucial for treatment planning and determining the most effective therapies.

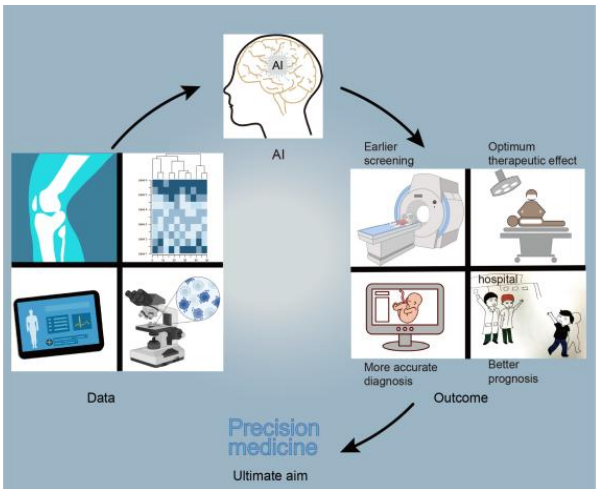
4. Risk Assessment: AI models can analyze patient data, such as genetics and lifestyle, to assess cancer risk, allowing for personalized screening and prevention strategies.

5. Treatment Guidance: AI can suggest treatment options based on a patient's unique profile, optimizing therapy choices and reducing side effects.

6. Progress Monitoring: AI can track tumor growth or regression during treatment, enabling doctors to adjust therapies as needed.

7. Reducing Human Error: It minimizes the potential for human error in diagnosis and provides consistent results.

8. Big Data Analysis: AI can process vast amounts of medical data, facilitating research, and the discovery of new insights and trends in cancer.



SCOPE

The scope of AI in cancer diagnosis is vast and offers significant potential for your research paper. AI technologies, such as machine learning algorithms and deep learning models, can analyze large datasets of medical images, genetic information, and clinical records to detect patterns and assist in early cancer diagnosis. These technologies enhance the accuracy and efficiency of diagnosing various types of cancers, leading to timely interventions and improved patient outcomes. Additionally, AI can aid researchers in analyzing complex genomic data to identify potential genetic markers and develop targeted therapies. Integrating AI into cancer diagnosis also promotes personalized medicine, tailoring treatments based on individual patient profiles. Furthermore, AI-powered tools can assist pathologists in analyzing tissue samples, reducing the time and human error associated with traditional methods. Overall, exploring these aspects in your research paper can provide valuable insights into the transformative role of AI in advancing cancer diagnosis and treatment.

FEATURES

1. Medical Image Analysis: AI can accurately analyze medical images, such as X-rays, MRIs, and CT scans, to detect abnormalities and tumors.

2. Early Detection: AI models can identify cancer at an early stage, increasing the chances of successful treatment and improving patient outcomes.

3. Tumor Classification: AI can classify tumors into different types, aiding in treatment planning and patient-specific care.

4. Risk Assessment: AI can assess an individual's cancer risk based on genetic, lifestyle, and clinical data.

5. Treatment Recommendations: AI can suggest personalized treatment options, taking into account the patient's unique profile.

6. Progress Monitoring: AI helps track the progression of tumors during treatment, enabling adjustments to therapy plans.

7. Reduction of Human Error: AI minimizes the potential for human errors in the diagnosis process, leading to more consistent and accurate results.

8. Big Data Analysis: AI can process and analyze large datasets of medical information, enabling researchers to uncover new insights and trends in cancer.

LITERATURE SURVEY

AI is known to assist cancer diagnosis and prognosis, given its unprecedented accuracy level, which is even higher than that of general statistical applications in oncology. An overview of how AI technology could be leveraged in this area and thereby contribute to improved human health.

These applications range from detection and classification of cancer, to molecular characterization of tumors and their microenvironment, to drug discovery and repurposing, to predicting treatment outcomes for patients. As these advances start penetrating the clinic, we foresee a shifting paradigm in cancer care becoming strongly driven by AI. AI includes techniques that enable computers to mimic the behavior of humans. The primary functions of AI in breast cancer screening are the segmentation and classification of benign or cancerous tumors. ML is a learning algorithm whose characteristics and variables represent observable data. DL is a typical example of ML, the methodology of which is dependent on deep neural networks that resemble but exaggerate human brain neurons and are used in the classification and recognition of images. DL uses a deep modular structure to promote hierarchies in learning and extracts information from simple to sophisticated models. However, there are several distinctions between ML and DL, so that AI will remain an effective diagnostic tool. Although multiple pieces of research have displayed significant results, there is still a need to address the challenges in cancer research in future.

PROBLEM STATEMENT

Artificial intelligence (AI), which is used to predict and automate many cancers, has emerged as a promising option for improving healthcare accuracy and patient outcomes. AI applications in oncology include risk assessment, early diagnosis, patient prognosis estimation, and treatment selection based on deep knowledge.

METHODOLOGY

AI Applications in Cancer Imaging

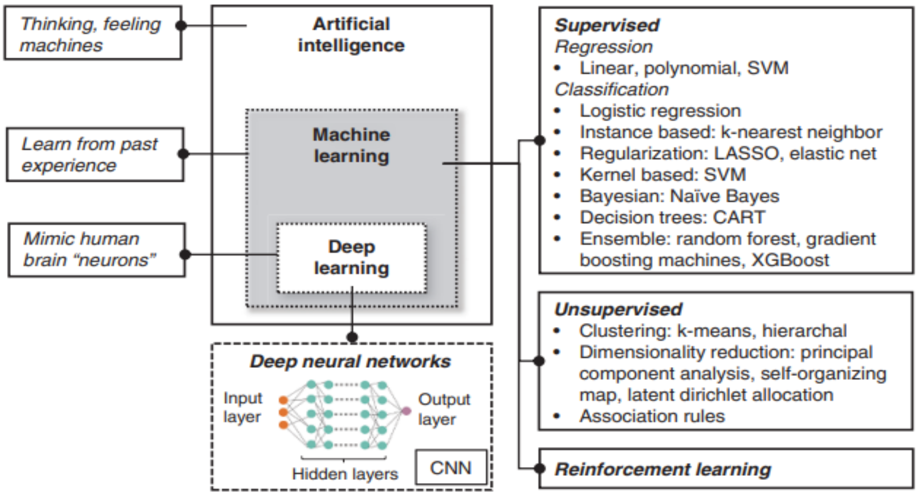
The desire to improve the efficacy and efficiency of clinical care continues to drive multiple innovations into practice, including AI. With the ever increasing demand for health care services and the large volumes of data generated daily from parallel streams, the optimization and streamlining of clinical work flows have become increasingly critical. AI excels at recognizing complex patterns in images and thus offers the opportunity to transform image interpretation from a purely qualitative and subjective task to one that is quantifiable and effortlessly reproducible. In addition, AI may quantify information from images that is not detectable by humans and thereby complement clinical decision making.

Diagnostic workflow Triage

Given increasing concerns about the limited diagnostic workforce and infrastructure, particularly after the COVID-19 pandemic which disrupted diagnostic workflows and halted screening programs [95,96], we are likely to see an increasing role for AI-based workflow triage in the near future. Such systems are intended to screen diagnostic test results and allocate cases for specialist review, for example by pathologists or radiologists, based on risk, so that the large volume of normal or low-risk examinations are not escalated.

Convolutional Neural networks workhorse for Image classification

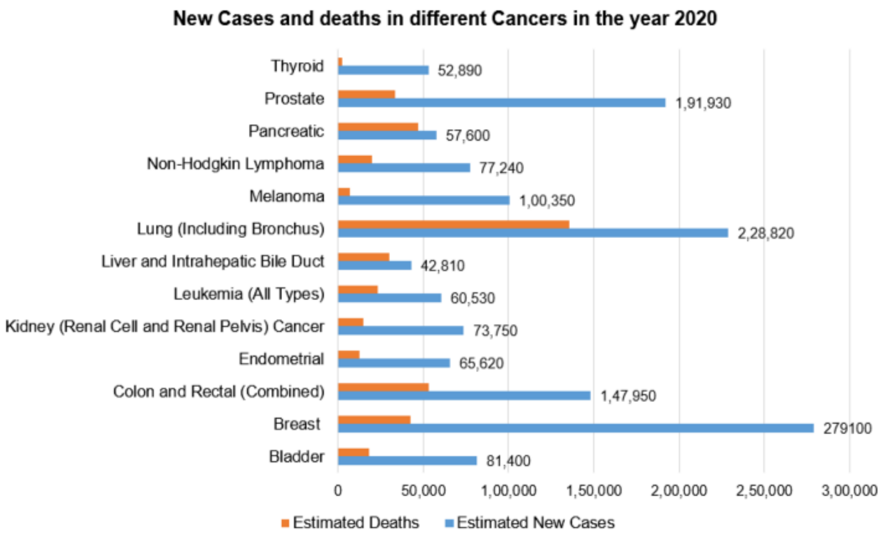
Convolutional neural networks (CNN) have been the most popular deep learning architectures used for image classification in cancer. CNNs apply a series of nonlinear transformations to structured data (such as raw pixels of an image) to learn relevant features automatically, unlike conventional machine learning models that frequently require manual feature curation. On the flip side, it is difficult to tell what features are learned by the CNNs, making them what many have referred to as a “black box.” One consequence is that images used for CNNs should be carefully preprocessed to reduce the risk that the model learns from image artifacts. There are two major approaches for CNN models; one is transfer learning that uses images from a large collection of natural objects (such as in ImageNet) to train the initial layers of a model (where the model learns to identify general features such as shapes and edges) and then uses the disease specific data to fi ne-tune the training parameters in the last layers.



MOTIVATION

The motivation behind this research is the rapid growth in cancer incidence and mortality cases worldwide. The reasons are complex but reflect both aging and growth of the population and changes in the prevalence and distribution of the main risk factors for cancer. Figure 1 depicts the cancer incidence cases and death statistics reported by the Ameri can Cancer Society and other reliable resources. Multiple investigations have been done in cancer research; for example, Rong et al. have led a mortality and survival study by gender orientation.

Dolatkhahet al. have introduced the investigation that revealed the endurance information and pattern examination of malignant breast growth in Iran. Summarized the diagnosis and treatment of thyroid cancer, with recommendations from the American Thyroid Association regarding thyroid nodules and differentiated thyroid cancer. Lee et al. [176] have stated that from March 18 to April 26, 2020, 800 patients analyzed with a diagnosis of cancer and symptomatic COVID-19. 412 (52%) patients had a mild COVID-19 disease course. 226 (28%) patients died, and the risk of death was significantly associated with advancing patient age. Al-Zhou et al. evaluated the demographic characteristics and histological trends of skin cancer in Southern areas of Yemen. Artificial Intelligence (AI) is one of the exceptional achievements of computer science conceived around the 1940s [5, 130]. AI has marked its significance in advanced clinical diagnostics by providing unique opportunities to incorporate the tools into the healthcare area. AI aims to analyze the association between treatment technique and patient outcomes.



CONCLUSION

We have seen that the application of AI to healthcare data has the potential to revolutionize early cancer diagnosis and provide support for capacity concerns through automation. AI may allow us to effectively analyze complex data from many modalities, including clinical text, genomic, metabolomic and radiomic data. In this review, we have identified myriad CNN models that can detect early-stage cancers on scan or biopsy images with high accuracy, and some had a proven impact on workflow triage.

Many commercial solutions for automated cancer detection are becoming available, and we are likely to see increasing adoption in the coming years. In the setting of symptomatic patient decision-support, we argue that caution is needed to ensure that models are validated and published in peer-reviewed journals before use. Moreover, we identified a number of challenges to the implementation of AI, including data anonymization and storage, which can be time-consuming and costly for healthcare institutions. We also addressed model bias, including the under-reporting of important demographic information such as race and ethnicity, and the implications this can have on generalizability.

In terms of how study quality and model uptake can be improved going forwards, quality assurance frameworks (such as SPIRIT-AI), and methods to standardize radiomic feature values across institutions, as proposed by the image biomarker standardization initiative, may help. Moreover, disease-specific, 'gold standard' test sets could help clinicians benchmark multiple competing models more readily. Despite the above challenges, the implications of AI for early cancer diagnosis are highly promising, and this field is likely to grow rapidly in the coming years..

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3. Acknowledge the contributions of research participants or study subjects, if applicable.
4. Mention anyone who helped with data collection, analysis, or technical assistance.
5. Express gratitude for emotional or moral support from friends and family during your work.
6. Keep the acknowledgment concise and focused on the key contributors, emphasizing their importance to the project's success.

REFERENCES

[1]. A. Allahyar, J. Ubels, J. de Ridder, A data-driven interactome of synergistic genes improves network based cancer outcome prediction, PLoSComputBiol, 15 (2019) e1006657.
[2]. C. Huang, C.I. Fong, M. Xu, B.-n. Han, Z. Yuan, Q. Zhao, Nano-loaded natural killer cells as carriers of indocyanine green for synergetic cancer immunotherapy and phototherapy, Journal of Innovative Optical Health Sciences, 12 (2019) 1941002.
[3]. K. Kourou, T.P. Exarchos, K.P. Exarchos, M.V. Karamouzis, D.I. Fotiadis, Machine learning applications in cancer prognosis and prediction, Comput Struct Biotechnol J, 13 (2015) 8-17.
[4]. R.L. Siegel, K.D. Miller, A. Jemal, Cancer statistics, 2019, CA: A Cancer Journal for Clinicians, 69 (2019) 7-34.
[5]. T. Ching, X. Zhu, L.X. Garmire, Cox-nnet: An artificial neural network method for prognosis prediction of high-throughput omics data, PLoSComputBiol, 14 (2018) e1006076.