Integrating Radiomics and AI in Precision Medicine: Transforming Head and Neck Cancer Management for Improved Outcomes

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INTRODUCTION

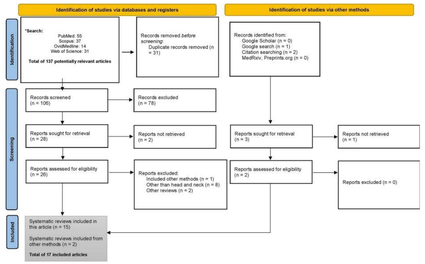
- With 4.6% of all worldwide cancer deaths due to cancers of the head and neck [HNC], there is an urgent need to optimize HNC care with a new multidisciplinary approach.
- One such promising approach is precision medicine, which holds the potential to revolutionize HNC care by using individualized care and genomic factors to guide a specific patient's treatment.
- Given the significant role of radiomics in the multiomics approach and application of Big Data in precision population medicine [PPM] and head and neck oncology, a discussion of artificial intelligence [AI] as it relates to radiomics is beneficial.
- The radiomics workflow involves segmentation, preprocessing, derivative image development, feature extraction, and modeling; AI, specifically machine learning, can analyze the radiomics data.
- This study aims to review how the integration of AI and radiomics improves the outcome for various HNC through personalized care in PPM.

METHODS

Narrative review utilizing MEDLINE/PubMed and Google Scholar to search literature between 1998-2023.

KEY WORDS SCREENED:

- precision medicine
- head and neck cancer
- AI
- combinations specific to these terms

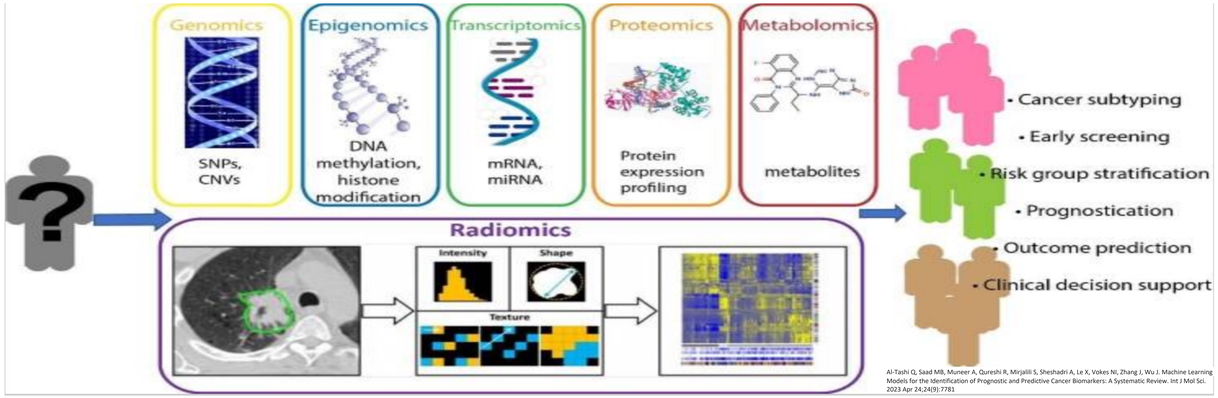


*Search: [("Artificial Intelligence OR Machine Learning") AND ("head and neck cancer") AND ("Systematic Review")]

Mäkitie AA, Alabi RO, Ng SP, Takes RP, Robbins KT, Ronen O, Shaha AR, Bradley PJ, Saba NF, Nuyts S, Triantafyllou A, Piazza C, Rinaldo A, Ferlito A. Artificial Intelligence in Head and Neck Cancer: A Systematic Review of Systematic Reviews. Adv Ther. 2023 Aug;40(8):3360-3380.

RESULTS

The Multiomic Approach

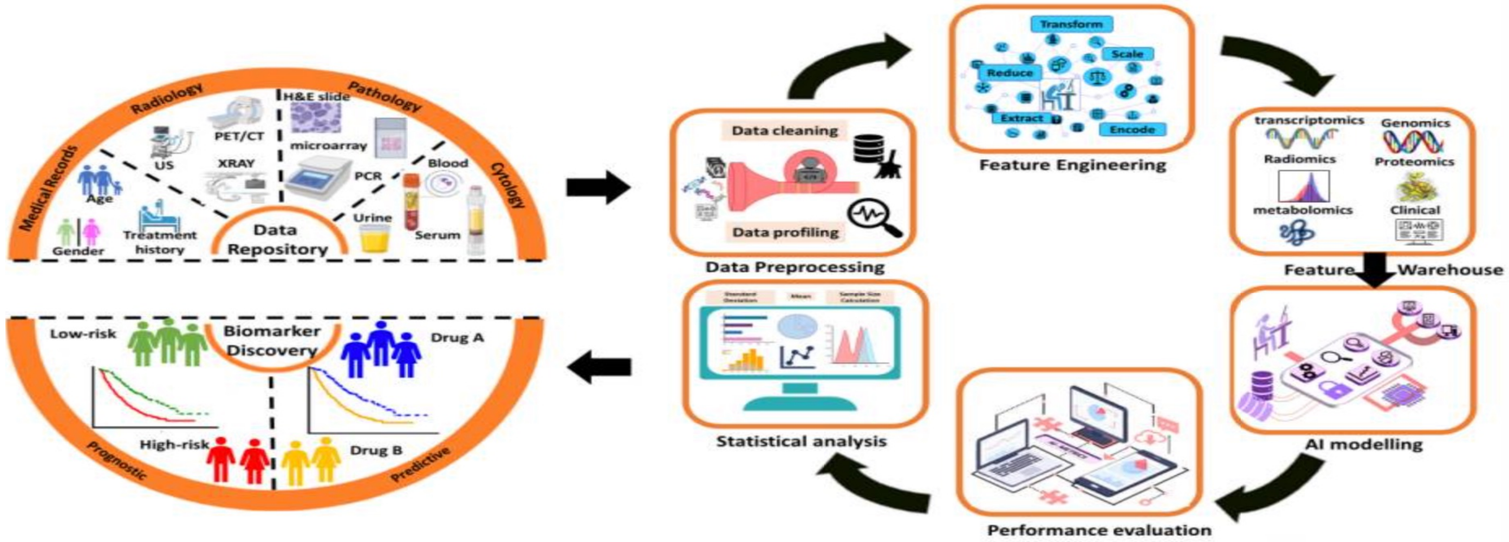


Al-Tashi Q, Saad MB, Muneer A, Qureshi R, Mirjalili S, Sheshadri A, Le X, Vokes NI, Zhang J, Wu J. Machine Learning Models for the Identification of Prognostic and Predictive Cancer Biomarkers: A Systematic Review. Int J Mol Sci. 2023 Apr 24;24(9):7781

In this era of rapid data growth, physicians, researchers, and data scientists must find unique solutions to filter relevant information due to the overwhelming volume of data.

RESULTS

A Generalized Schematic Depicting Machine Learning with the Integration of AI and Big Data



Big Data can be prepared and analyzed to elucidate prognostic and predictive biomarkers

Wei L, Niraula D, Gates EDH, Fu J, Luo Y, Nyflot MJ, Bowen SR, El Naqa IM, Cui S. Artificial intelligence (AI) and machine learning (ML) in precision oncology: a review on enhancing discoverability through multiomics integration. Br J Radiol. 2023 Oct;96(1150):20230211.

DISCUSSION

Revolutionizing Treatment Paradigms for HNC

- PPM tailors individualized prevention, intervention and treatment plans for HNC to specific populations by isolating genetic and environmental factors unique to each population.
- The goal of this approach is to take patient-centered care a step further by implementing biomedical tools to incorporate individual data into treatment, such as lifestyle, age, race, environment, and specific genetic biomarker information of both the tumor and the patient.
- AI data mining can efficiently create databases for multifactorial comparisons that test HNC distribution in these populations.
- Radiomic data analyses via AI based machine learning yield clinical relevance regarding prognostic determination, diagnostics, and various medical applications.
- Prognostic models derived from Big Data and multiomics benefit PPM and give rise to therapeutic advancements and diagnostics on an individual level regarding HNC.

CONCLUSION

Integrating radiomics and AI along with support from big data creates a driving force for major advancements in HNC care and intervention through PPM. This paper illimunates the innovative approaches and suggestions regarding the various modalities that are considered by PPM.

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2. Mäkitie AA, Alabi RO, Ng SP, Takes RP, Robbins KT, Ronen O, Shaha AR, Bradley PJ, Saba NF, Nuyts S, Triantafyllou A, Piazza C, Rinaldo A, Ferlito A. Artificial Intelligence in Head and Neck Cancer: A Systematic Review of Systematic Reviews. Adv Ther. 2023 Aug;40(8):3360-3380. doi: 10.1007/s12325-023-02527-9. Epub 2023 Jun 8.
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