

# Evolving Role of Artificial Intelligence and Radiomics in Precision Population Medicine for Cancer Care: Defining the Boundaries of Precision Population Medicine

Chanukya Cherukuri<sup>1</sup>, Johnny Yang<sup>1</sup>, Jeffrey A Roux<sup>1</sup>, John D Salvemini<sup>1</sup>, Bradley Hathaway<sup>1</sup>, Gregory Vance<sup>1</sup>, Camille Grady<sup>1</sup>, Mary Nittala<sup>2</sup>, Vani Vijayakumar<sup>2,3</sup>, Srinivasan Vijayakumar<sup>4</sup>

<sup>1</sup>School of Medicine, UMMC, <sup>2</sup>Department of Radiation Oncology, UMMC, <sup>3</sup>Department of Radiology, UMMC, <sup>4</sup>Cancer Care Advisors and Consultants, LLC

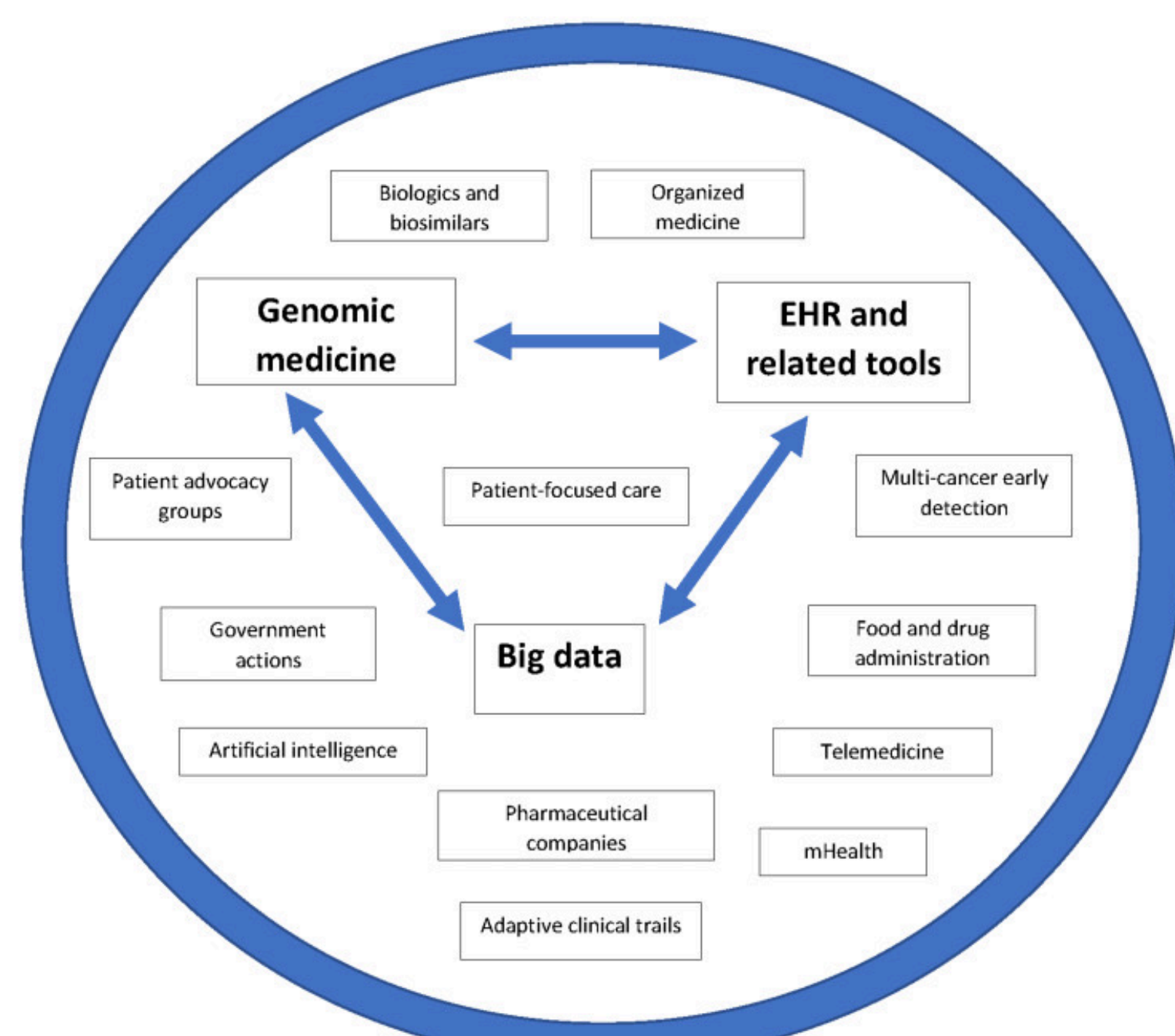
## INTRODUCTION

### OBJECTIVES:

- To accurately define precision medicine (PM) and discuss its potential to improve cancer care.
- To elucidate an improved, expanded definition of PM: precision population medicine (PPM).
- To discuss the implementation of artificial intelligence (AI) and radiomics (R) into PPM.

### PRECISION MEDICINE:

- An emerging approach for treating and preventing diseases that consider gene variability, environment, lifestyle, and social factors for each patient.
- Allows physicians and researchers to optimize care for higher-risk groups and populations.
- Includes genomic medicine (GM) but is more broad and encompassing than GM.



Yang J, Nittala MR, Velazquez AE, Buddala V, Vijayakumar S. An Overview of the Use of Precision Population Medicine in Cancer Care: First of a Series. *Cureus*. 2023 Apr 20;15(4):e37889.

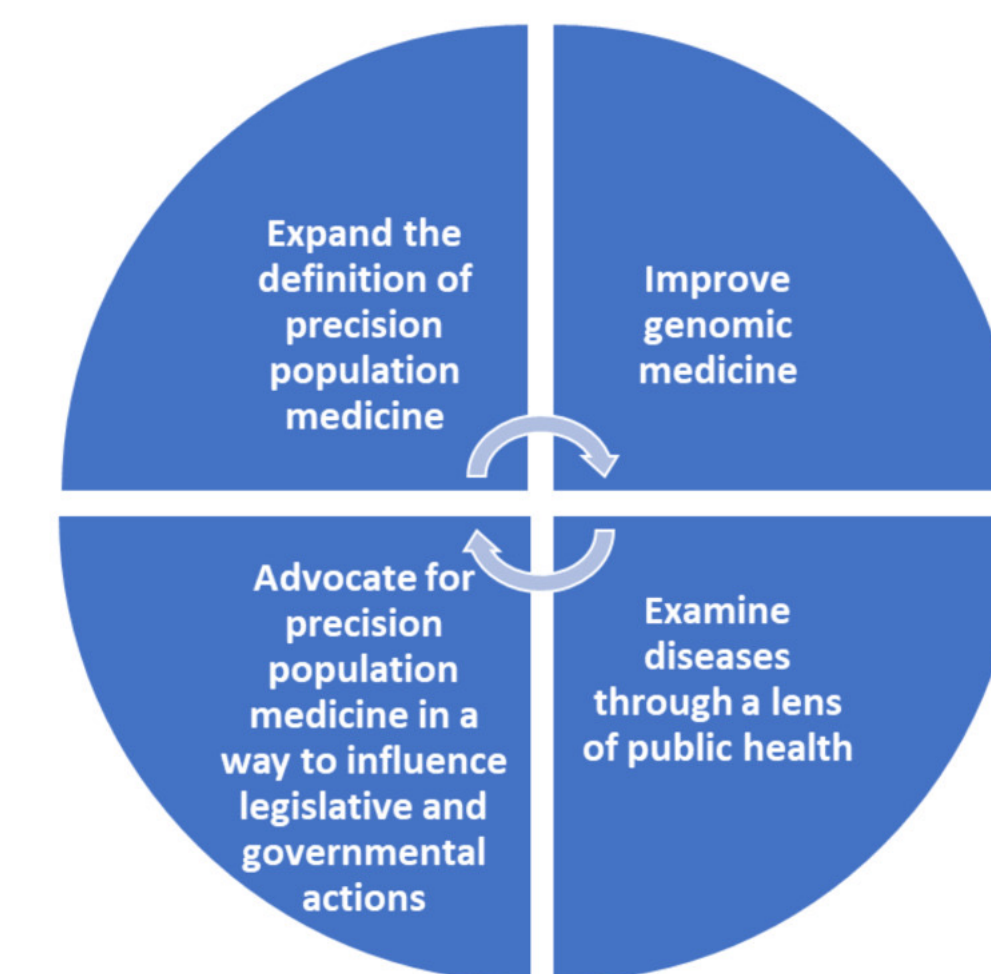
## METHODS

- Databases Medical Literature Analysis and Retrieval System Online (MEDLINE)/PubMed and Google Scholar were used for literature searches between 1997 and 2023.
- Key words: “precision medicine,” “radiomics,” “artificial intelligence,” “genomic medicine,” and “big data.”
- Information about PPM and examples of its usage in combination with AI and R were gathered from these papers and incorporated into this comprehensive review.
- Editorial, commentaries, and unpublished works were excluded.

## RESULTS

### What is PPM?

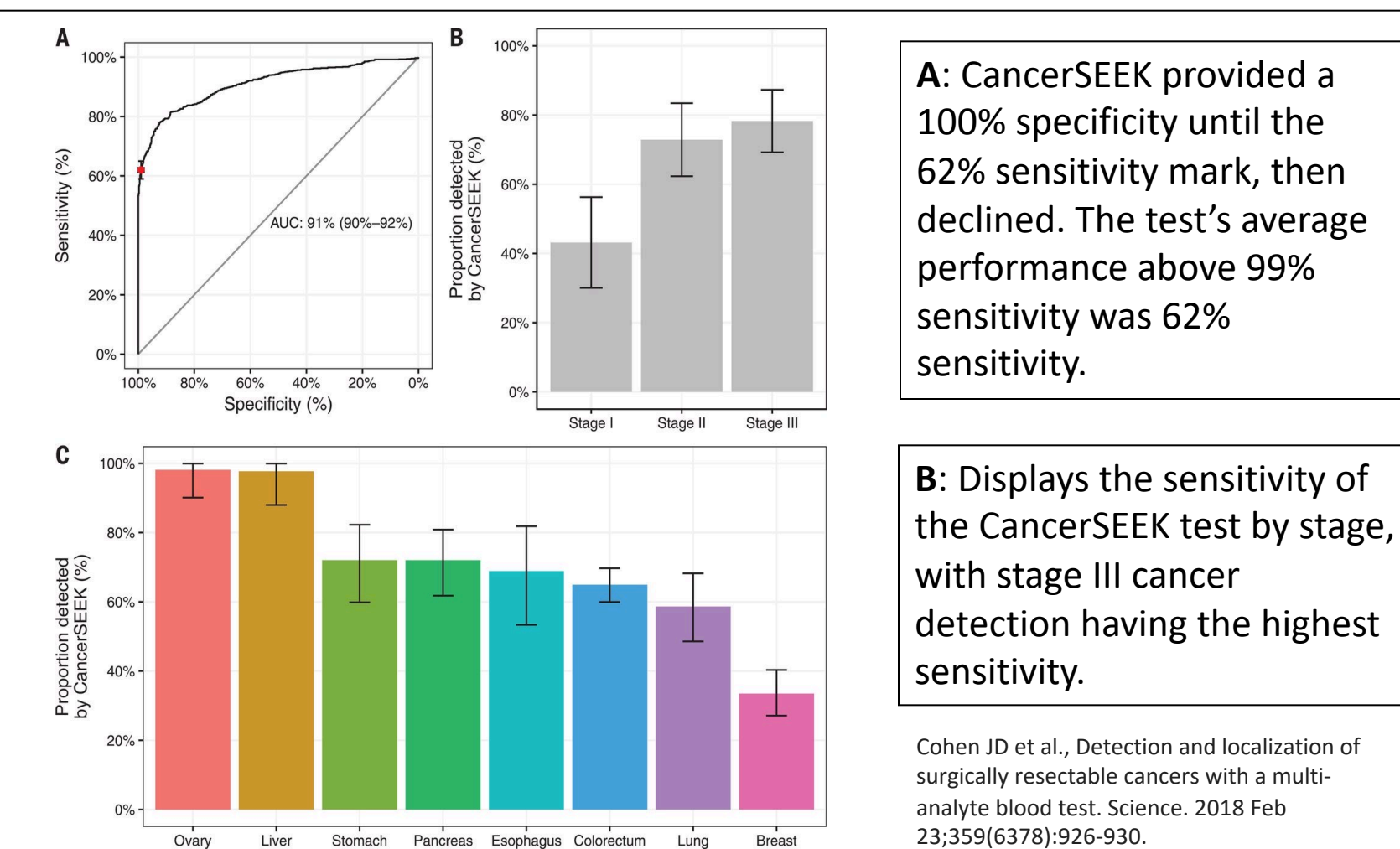
- The authors have coined the novel term “population precision medicine” as an expanded application of PM. It combines big data, telemedicine, and population health goals with genomic markers and biological/social factors when treating patients.
- This expanded definition can improve the differentiation of population health (PH) and GM goals, allowing future developments in each field.
- Future studies will provide the opportunity to evaluate PPM through different views, such as cancer care.



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### Application of AI in PPM - CancerSEEK Blood Test:

- A liquid biopsy test that uses combined assays for genetic alterations and protein biomarkers is able to both identify the presence of cancer and localize the origin of the cancer.
- A trial by Cohen et al. showed that the CancerSEEK test displayed up to a 98% sensitivity in ovarian cancer screening but a 33% sensitivity in breast cancer screening. The median sensitivity was 70% across the eight most common cancer types.



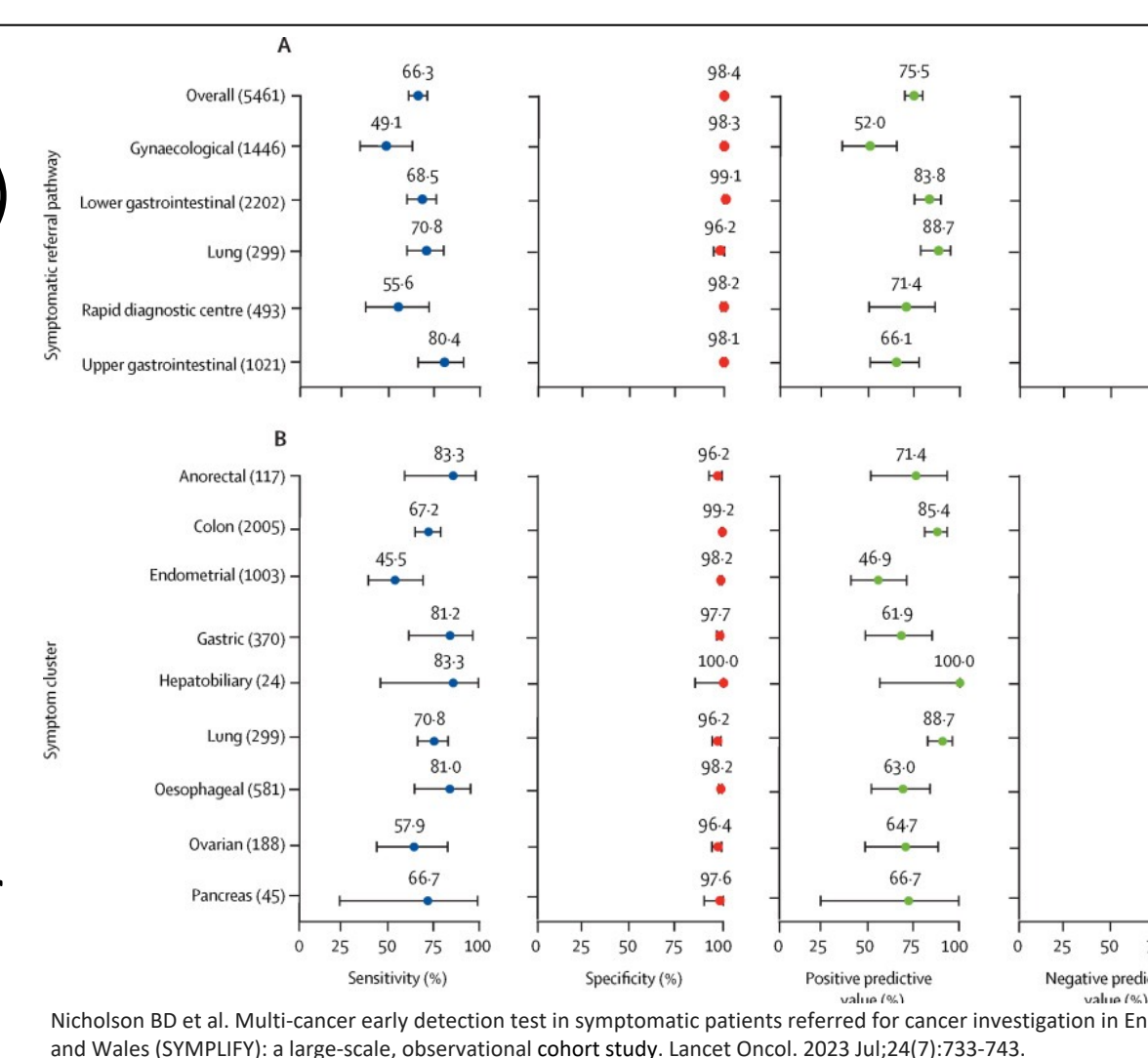
A: CancerSEEK provided a 100% specificity until the 62% sensitivity mark, then declined. The test's average performance above 99% sensitivity was 62% sensitivity.

B: Displays the sensitivity of the CancerSEEK test by stage, with stage III cancer detection having the highest sensitivity.

Cohen JD et al. Detection and localization of surgically resectable cancers with a multi-analyte blood test. *Science*. 2018 Feb 23;359(6378):926-930.

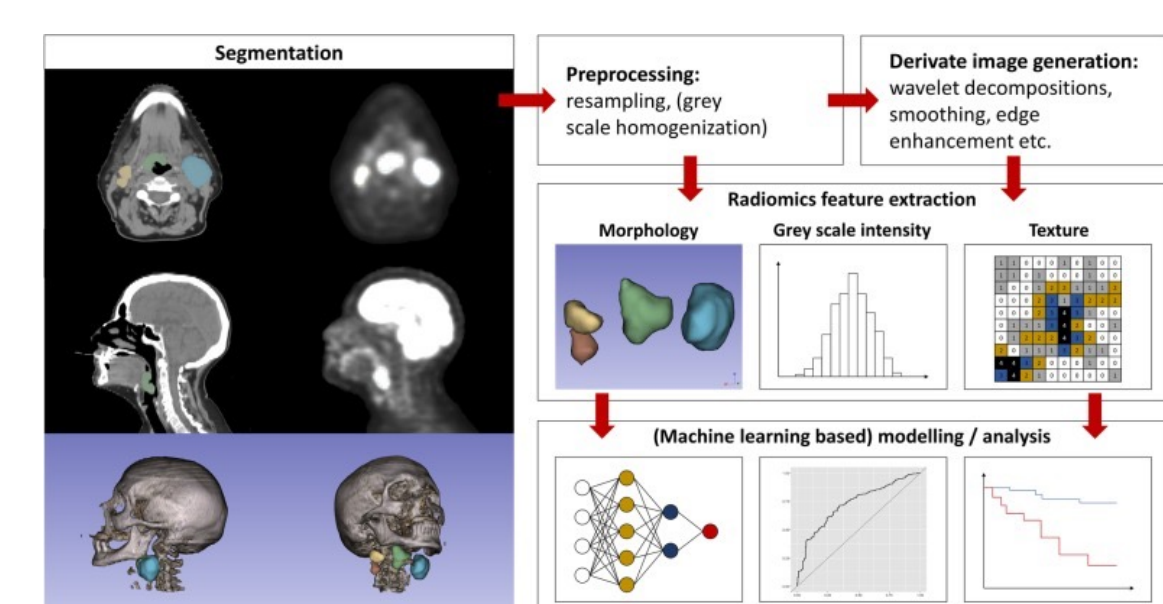
### Application of AI in PPM – Multi-Cancer Early Detection (MCED):

- Blood-based tests that measure cancer biomarkers (genetic and epigenetic) by circulating tumor DNA and protein cancer cells produce.
- Typically used for screening in asymptomatic populations or detection of cancer recurrence.
- A study by Nicholson et al. (SYMPLOY) investigated MCED performance in symptomatic patients, yielding an overall sensitivity of 66.3% and a 98.4% specificity across all cancers.
- The figure to the right depicts sensitivity, specificity, positive predictive values, and negative predictive values for each of the most common cancer types using MCED.



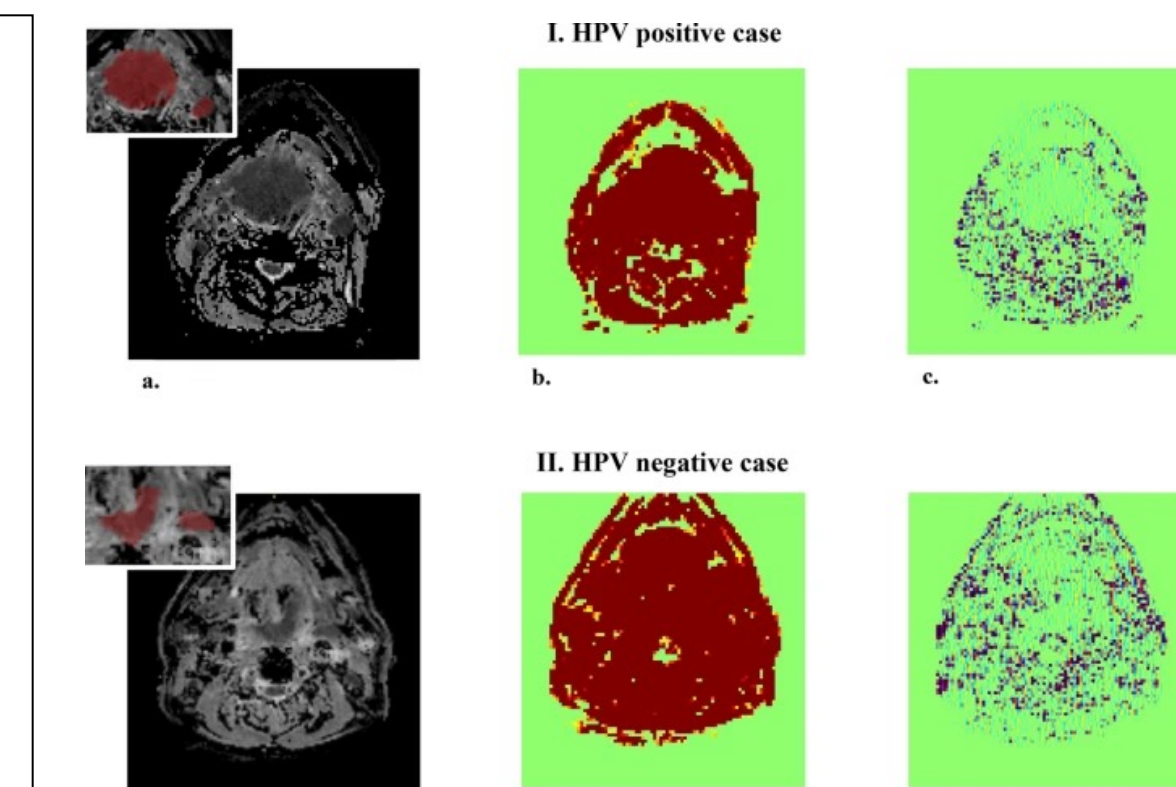
Nicholson BD et al. Multi-cancer early detection test in symptomatic patients referred for cancer investigation in England and Wales (SYMPLOY): a large-scale, observational cohort study. *Lancet Oncol*. 2023 Jul;24(7):733-743.

### Applications of R in PPM:



Haider SP, Burtneis B, Yarbrough WG, Payabvash S. Applications of radiomics in precision diagnosis, prognostication and treatment planning of head and neck squamous cell carcinomas. *Cancers Head Neck*. 2020 May 4;5:6.

- Radiomics has displayed boundless potential for use in PPM.
- The chart on the left depicts the typical radiomics workflow, and using this workflow, innovations, such as the detection of HPV status using computed tomography (CT), are possible (depicted on the right).
- Additional uses for R in PPM include detecting the presence of genetic mutations and cancer-specific histologic/molecular subtypes on imaging.



Suh CH et al. Oropharyngeal squamous cell carcinoma: radiomic machine-learning classifiers from multiparametric MR images for determination of HPV infection status. *Sci Rep*. 2020 Oct 16;10(1):17525.

## CONCLUSIONS

- AI and R will play pivotal roles in PPM in the future, as they can aid with genomic characterization of tumors, cancer surveillance in large populations, and radiomic evaluations of imaging.
- Although the efficacy of many techniques aligned with PPM has yet to be established, this novel hypothesis has the potential to improve cancer outcomes by emphasizing individualized, comprehensive treatment plans for each patient, while applying similar principles to entire populations.

## REFERENCES

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Suh CH et al. Oropharyngeal squamous cell carcinoma: radiomic machine-learning classifiers from multiparametric MR images for determination of HPV infection status. *Sci Rep*. 2020 Oct 16;10(1):17525.

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## CONTACTS

- Chanukya Cherukuri: [Ccherukuri@umc.edu](mailto:Ccherukuri@umc.edu)
- Srinivasan Vijayakumar: [svijayakum@aol.com](mailto:svijayakum@aol.com)