

# Thymic Health is Linked to Cancer Patients' Response to Immunotherapy

Assessing the health of the thymus may help guide patient selection for immunotherapy alongside existing biomarkers.

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- Higher thymic health is linked to better outcomes with immunotherapy in various cancer types.
- AI-driven CT scan analysis can track thymic health and indicate immune function.
- Assessing thymic health may help guide patient selection for immunotherapy alongside existing biomarkers, further enhancing precision oncology.

Lugano/Berlin — The health of the thymus—a key part of the body's immune system—is associated with cancer patients' outcomes to immune checkpoint inhibitor treatment, according to a ground-breaking international study reported at [ESMO 2025](#).

"Immune checkpoint inhibitors have transformed cancer treatment, but responses remain limited in some patients," said lead author Dr. Simon Bernatz, of the AI in Medicine Program at Mass General Brigham, Boston, USA. He noted that current biomarkers for immunotherapy, such as PD-L1 or tumour mutational burden (TMB), focus on tumour characteristics but largely overlook patients' immune capacity.

The new study investigated whether thymic health might be associated with response to immunotherapy by analysing routine chest CT scans from nearly 3500 real-world patients treated with immune checkpoint inhibitors. Using an AI tool based on a deep learning framework developed to carry out multi-layered analysis of data from CT scans, researchers assessed thymic size, shape and structure to score thymic health, and examined how these scores related to patients' outcomes with immunotherapy.

Results showed that higher thymic health was associated with a 35% lower risk of cancer progression (hazard ratio [HR] 0.65; 95% confidence interval [CI] 0.54-0.77) and 44% lower risk of death (HR 0.56; 95% CI 0.46-0.68) in the group of just over 1200 patients with non-small cell lung cancer included in the study. There was also a positive association between thymic health and immunotherapy outcomes in patients with other cancers, including melanoma, renal and breast

cancers.

A further part of the study confirmed that the deep learning analysis of CT scans provided a valid proxy for thymic health. The researchers sequenced T-cell receptors and their associated proteins in a sub-group of 464 patients with non-small cell lung cancer. This gave detailed information on T cell differentiation and function; the results correlated with thymic health as assessed using the new AI tool for analysing CT scans.

“Immunotherapy relies on unleashing T cells and the thymus is where T cells are matured. Our study shows that thymic health is associated with improved immunotherapy outcomes across diverse cancer types,” explained Dr Bernatz.

Looking to the future, he believes the findings suggest that thymic health could serve as a non-invasive biomarker of adaptive immune competence in a range of different cancers. “Thymic health has the potential to enhance patient stratification in precision oncology,” he suggested. “Randomised clinical trials will be needed to establish this in clinical practice. But we think thymic health is one of the missing pillars from current cancer biomarker panels and can start bringing the patient’s immune system into clinical decision making alongside established tumour-centred biomarkers.”

“The main limitation of the finding is that it has not been validated prospectively. We need a prospective study including evaluation of thymic health in patients undergoing immunotherapy,” said Dr Alessandra Curioni-Fontecedro, Professor of Oncology at the University of Fribourg, Switzerland, not involved in the study. However, she noted that the inclusion of a validation cohort added to the study’s quality and that, although thymic health is not routinely assessed, chest CT scans are commonly performed in patients with cancer.

“There are many reasons why we need new biomarkers for immunotherapy in cancer patients,” Curioni-Fontecedro suggested. “In lung cancer, we need biomarkers to guide whether to give patients immunotherapy alone or in combination with other treatments, such as chemotherapy. And we need better biomarkers for prognosis in individual patients.”

Abstract 1080: Thymic health is associated with immunotherapy outcomes in patients with cancer. Presented by Dr. Simon Bernatz during Proffered Paper Session 1: Basic Science & Translational Research, October 18, 2025.

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