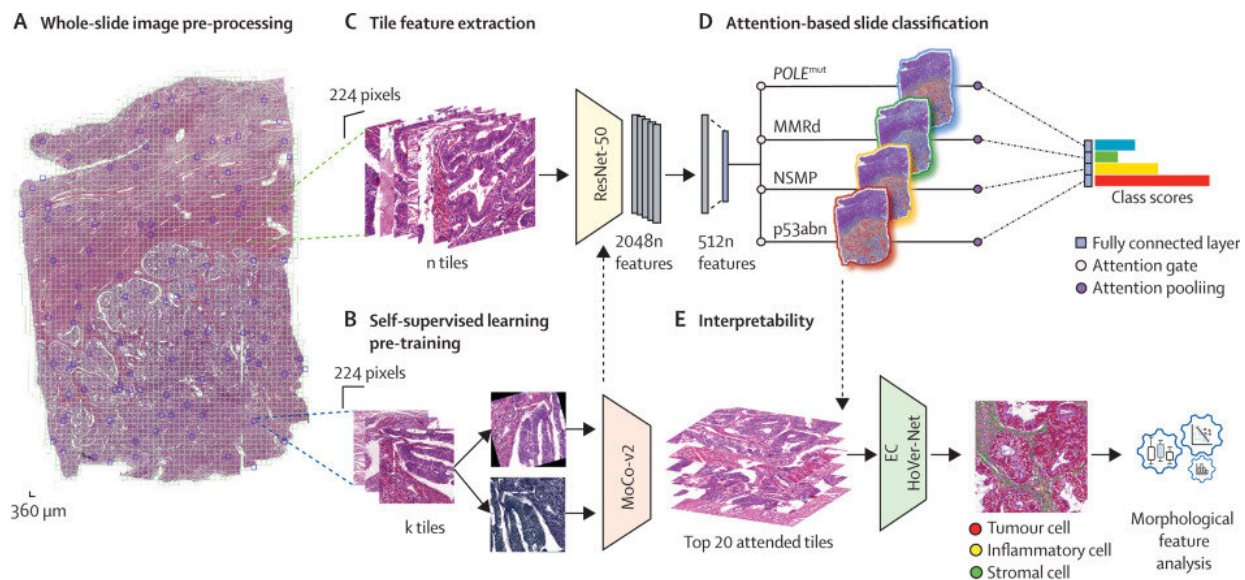


# AI application in pathology reveals novel insights in endometrial cancer diagnostics

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im4MEC deep learning pipeline. (A) Whole-slide images were segmented and cut into non-overlapping square tiles of 360  $\mu\text{m}$  at 40 $\times$  magnification and resized to 224  $\times$  224 pixels. (B) The optimal number of tiles were sampled from each whole-slide image to build a training dataset for the MoCo-v2 self-supervised learning model. (C) Features were extracted from all tiles of the whole-slide image by use of the self-supervised learning encoder, ResNet-50, at the last layer resulting in features of size 2048. (D) The model was trained to molecularly classify the whole-slide image, assigning attention scores to each tile and molecular class. Attention heatmaps are displayed from low attention (blue) to high attention (red). (E) The top 20 attended tiles were extracted from the predicted attention branch only. The predictions of HoVer-Net, a nuclear segmentation and classification deep learning model trained on an endometrial cancer tile image dataset, were used to compute counts of the three cell types and

size and shape of the tumor nuclei (appendix 1 p 29). Subsequent analyses described these morphological features in association with the molecular classes and measured their relative feature importance with a support vector machine. MMRd=mismatch repair protein deficient. NSMP=no specific molecular profile. p53abn=abnormal cellular tumor antigen p53 expression. Credit: *The Lancet Digital Health* (2022). DOI: 10.1016/S2589-7500(22)00210-2

Research at the Leiden University Medical Center (LUMC) Department of Pathology shows the power of artificial intelligence (AI) applied to endometrial carcinoma microscopy images. The group of Dr. Tjalling Bosse offers novel insights that could improve diagnosis and treatment of uterine cancer. Their findings have been published in *The Lancet Digital Health*.

Endometrial carcinoma is the most common [cancer](#) of the gynecologic tract. At the LUMC both [clinical trials](#) and translational research are conducted to improve the care for these patients. In the past years, the LUMC has had a leading role in the development of a novel tumor classification system based on [molecular alterations](#), resulting in four endometrial cancer subtypes. Would it be possible to predict these molecular classes, based on microscopy-images alone?

## **Thousands of images**

Bosse and colleagues applied [artificial intelligence](#) on microscopy images of thousands of endometrial carcinoma images from patients that participated. His team developed a model that robustly predicts the four molecular classes of endometrial carcinomas based on one (hematoxylin and eosin)–stained microscopy slide image, which is the standard histological stain used in diagnostics for assessment of tumor grading and histological subtyping.

This model was not "a black-box," but through reverse-engineering the researchers were able to show which image-features were relevant for its predictions. The model provided the team with important novel insights that can be utilized in future studies to further improve diagnostics, prognostication, and management of endometrial cancer patients.

## Emerging application of AI

"The application of AI in pathology is emerging. In this project we studied the morphology of tumors that shared the same molecular alteration to better understand the effect these changes have on the appearance of the tumor. With this work, the [computer model](#) has directed us to areas inside and outside the tumor that are important," Bosse notes.

"In cancer diagnostics, the number of variables (molecular, tumor morphology, patient data) has increased exponentially and has complexified patient prognosis prediction. Through training unbiased AI models, AI predictions can also teach pathologists in return by, for instance, identifying novel morphological details on microscopy slide images with prognostic value," says Sarah Fremond.

**More information:** Sarah Fremond et al, Interpretable deep learning model to predict the molecular classification of endometrial cancer from haematoxylin and eosin-stained whole-slide images: a combined analysis of the PORTEC randomised trials and clinical cohorts, *The Lancet Digital Health* (2022). [DOI: 10.1016/S2589-7500\(22\)00210-2](https://doi.org/10.1016/S2589-7500(22)00210-2)

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