

Triaging Cutaneous Melanocytic lesions using Artificial Intelligence

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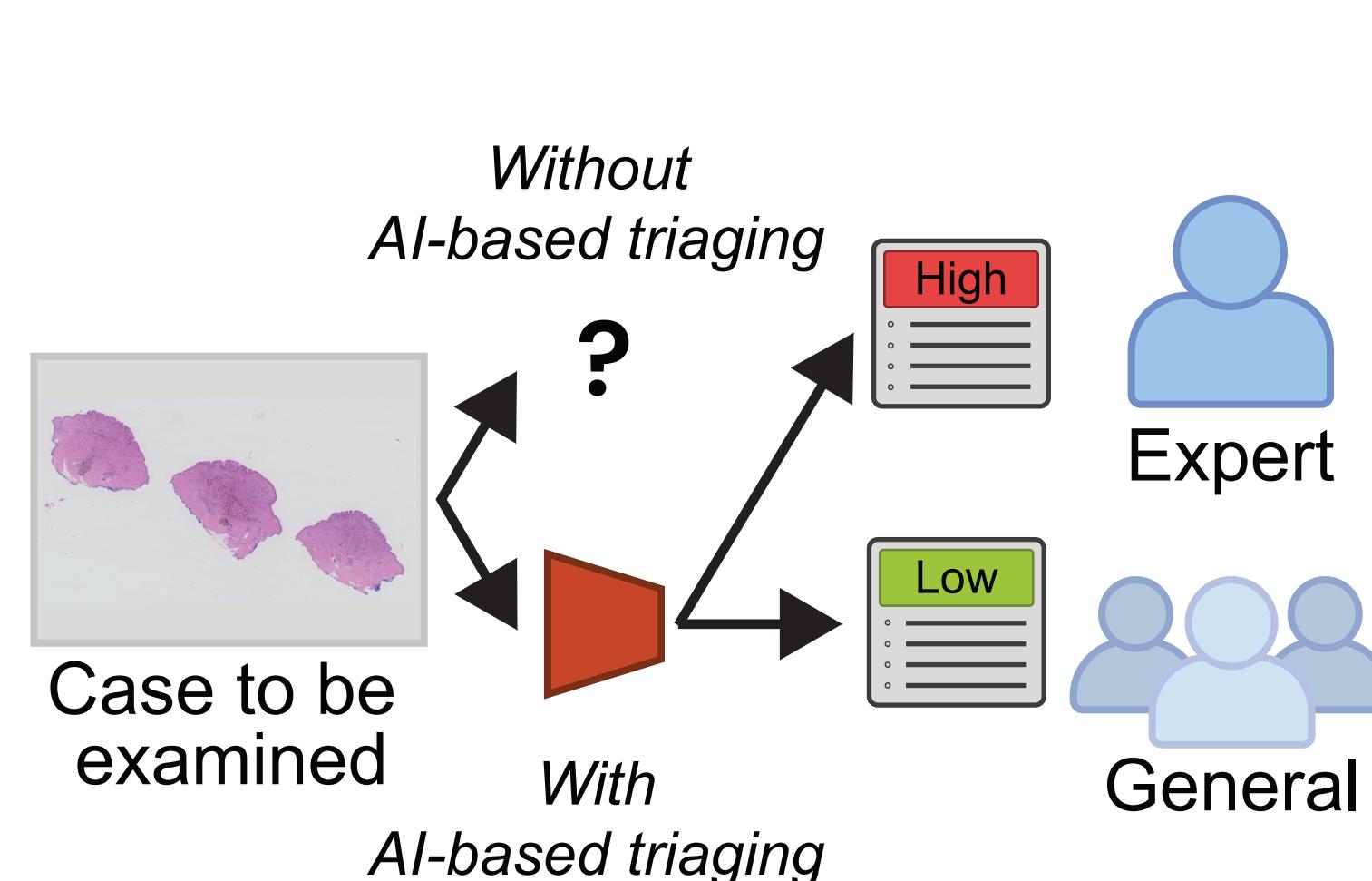
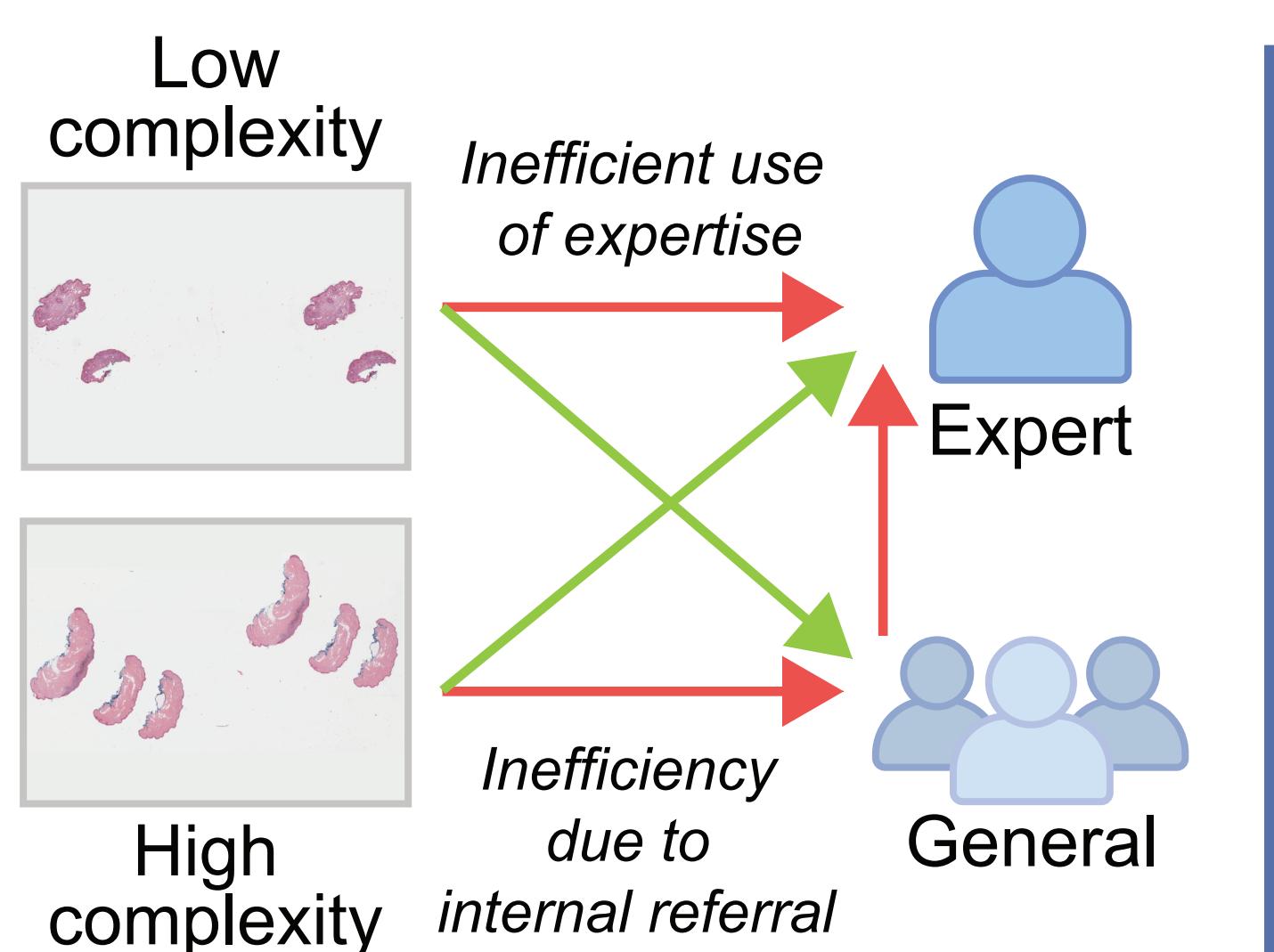
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Motivation



Pathologists are facing an increasing workload due to a growing volume of cases and the need for more comprehensive diagnoses [1]. The transition to fully digital pathology departments enables the implementation of artificial intelligence (AI) models for workflow optimization to improve efficiency and patient care.

One promising direction is the application of AI models for automated triaging of cases before initial examination by a pathologist. For example, directly assigning all high complexity cases to the pathologist with most expertise can prevent double examinations.

We developed an AI model for triaging cutaneous melanocytic lesions based on whole slide images, aiming to facilitate workload reduction and faster turnaround times.

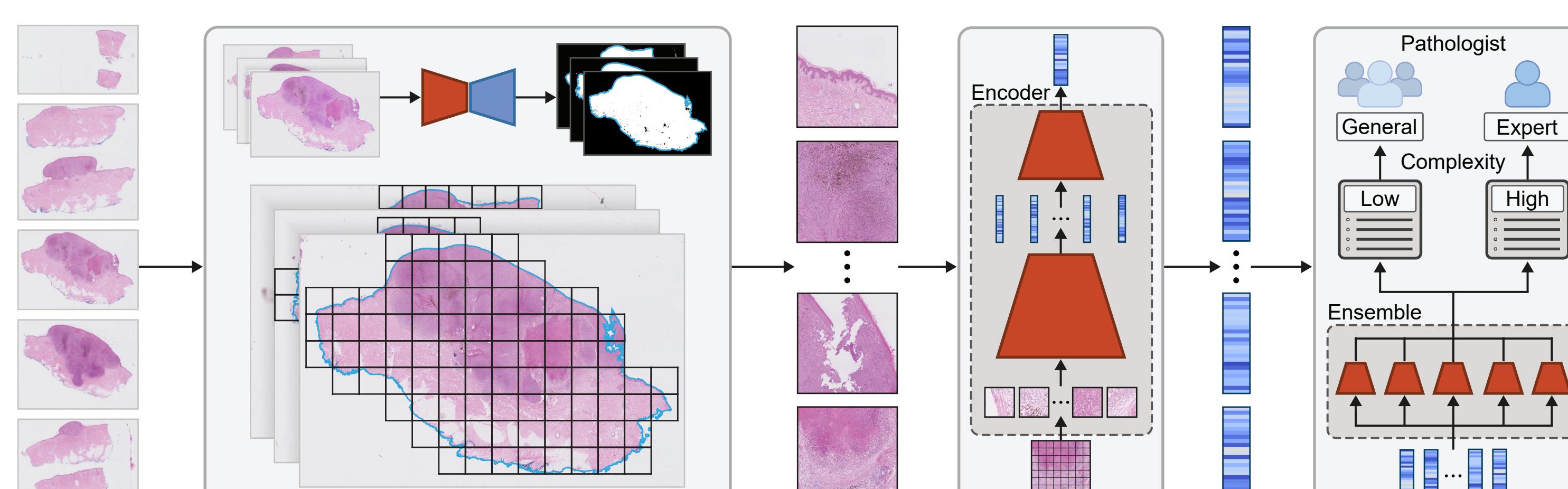
Dataset

The AI model was developed and validated using a retrospective cohort from the University Medical Center Utrecht, the Netherlands. The dataset consisted of **52,202** whole slide images (WSIs) from **27,167** unique specimens, acquired from **20,707** patients.

Specimens with only common nevi were assigned to the **low complexity (86.6%)** category. Specimens with any other melanocytic lesion subtype, were assigned to the **high complexity (13.4%)** category.

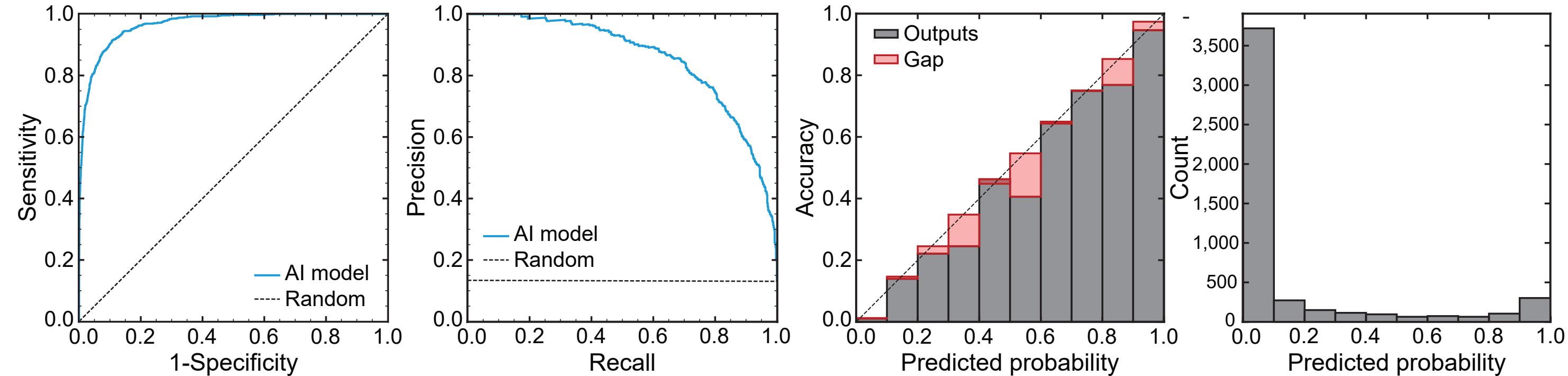
The dataset was split into a development set (80%) and **two test sets** (20%): (1) Primary set with the same distribution as development set ($N = 4957$); (2) Out-of-distribution set with specimens with non-melanocytic skin pathologies in addition to a melanocytic lesion ($N = 480$).

Methods

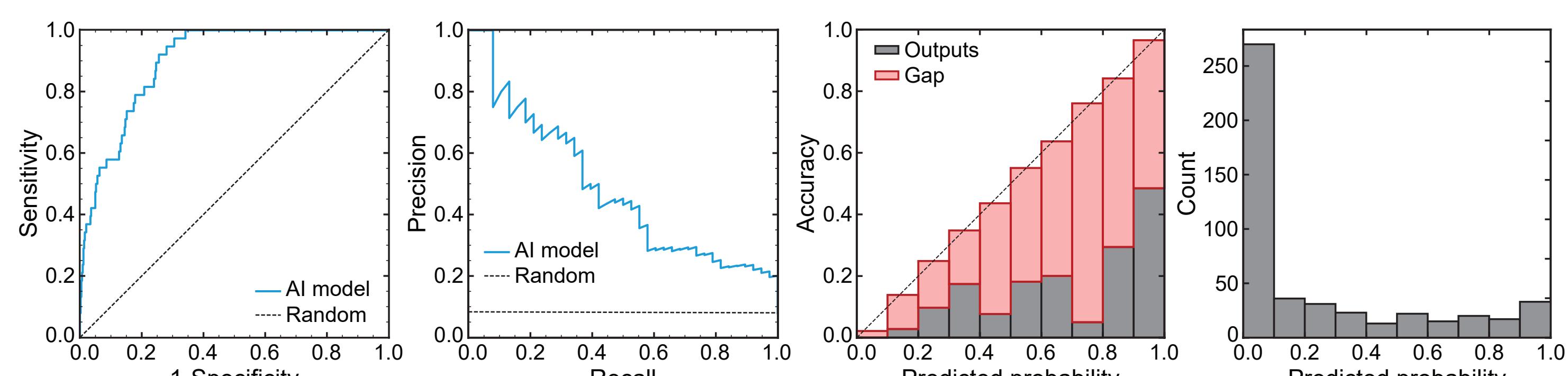


Each case consisted of one or multiple WSIs. Tissue regions were segmented using SlideSegmenter [2] to guide the tessellation. All tiles were converted to feature vectors using the Hierarchical Image Pyramid Transformer (HIPT) [3]. An ensemble of five Vision Transformers (ViTs) [4] were trained to predict the diagnostic complexity of the case based for assignment to a general or expert pathologist.

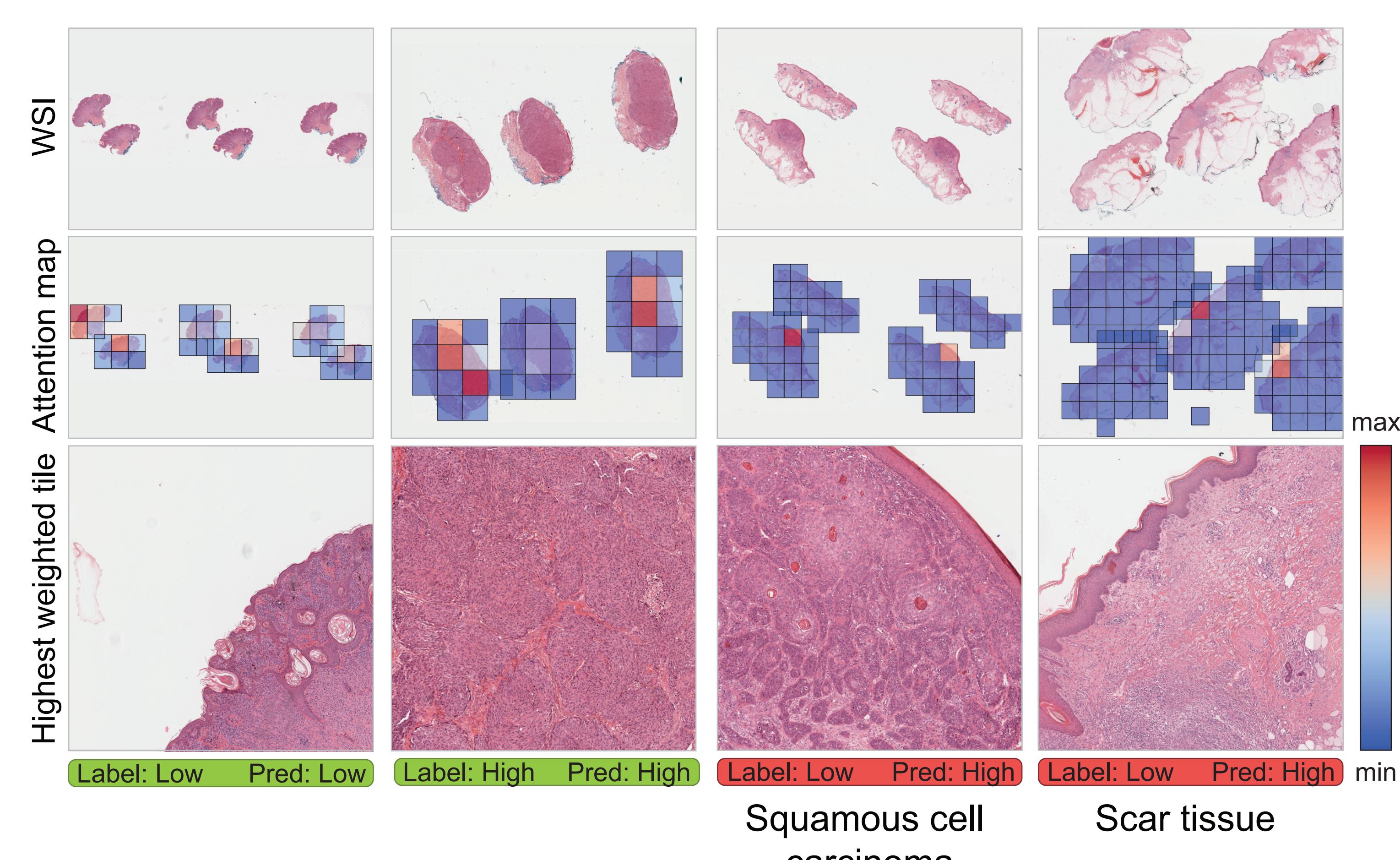
Results



On the primary test set, the AI model reached an AUROC of **0.966** and an AUPRC of **0.857**. Predicted probabilities by model were well-calibrated based on the reliability diagram, with an ECE of 0.010.



On the out-of-distribution test set, the AI model obtained an AUROC of **0.899**, an AUPRC of **0.498**, and an ECE of 0.160. The lower AUPRC can be explained by the larger number of false positives due to the non-melanocytic lesions present.



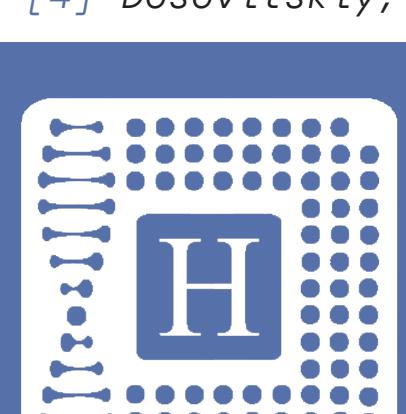
Simulation

Through simulation, we estimated that, on average, **43.9** initial examinations of high complexity cases by general pathologists could be prevented with AI-based triaging per 500 cases, using five pathologists of which one expert and random case assignment as baseline. When accounting for consultation and revision cases by assigning these to the expert pathologist first, an average of **34.5** initial examinations could be prevented.

Conclusion

The AI model reached a strong predictive performance in differentiating between melanocytic lesions of high and low complexity. Using simulation, we demonstrated that implementing AI-based triaging for case assignment could substantially improve the workflow efficiency.

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