

How is Artificial Intelligence changing the way we predict colorectal cancer patient outcomes?

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BACKGROUND

- Colorectal cancer (CRC) is the **third most diagnosed cancer** worldwide and the **second leading cause of cancer death**.¹
- The **stage at diagnosis** is a major determinant of survival², yet patients within the same stage can experience different outcomes, highlighting the need for more individualised risk assessment.
- Given the growing burden of CRC, artificial intelligence (AI) offers a promising approach to improve outcome prediction by integrating clinical, pathological, imaging and molecular data to identify patterns associated with survival, recurrence and treatment response. However, the extent to which these models are validated and can inform clinical decision-making remains uncertain.

AIM

- To evaluate how AI is being used to predict CRC outcomes, assess the strength of validation supporting these approaches and identify the barriers to their implementation in routine clinical practice

DISCUSSION

Histopathology: AI-derived histological features may improve prognostic stratification beyond conventional factors, including within the same disease stage, but prospective validation is needed.

Blood-based testing: AI can analyse blood test results to support earlier CRC detection and identify patients at higher risk of recurrence or death, although clinical benefit and generalisability remain uncertain.

Radiology: Radiomics and deep learning approaches have been applied to predict metastasis, recurrence and survival, allowing for more individualised risk assessment, but limited external validation restricts clinical applicability.

Colonoscopy: AI improves adenoma detection, but effects on advanced lesions and CRC mortality remain uncertain. Potential harms include additional surveillance and endoscopist deskilling.

Survival prediction: AI enables individualised survival estimates, but machine-learning models do not consistently outperform conventional statistical methods.

Barriers to implementation

- Generalisability: External validation varied across domains, no prognostic model was tested prospectively, and performance declined in some external populations.
- Clinical integration: Limited model transparency, infrastructure costs and workflow challenges
- Clinical utility and reporting: predictive accuracy does not guarantee improved patient outcomes. Adoption of TRIPOD+AI and PROBAST+AI may improve reporting and appraisal of AI prediction models.^{3,4}

Limitations

- Searches were limited to MEDLINE and Embase.
- Differences in data sources, outcomes, model types and performance metrics prevented quantitative synthesis or direct comparison between approaches.
- Study selection prioritised externally validated models, so validation counts may overstate that of the wider literature.

CONCLUSION

AI shows promise for more individualised CRC outcome prediction, potentially complementing conventional staging and prognostic assessment. Emerging approaches, including pathology foundation models and multimodal AI, may further improve predictive capabilities. However, limited external validation and evidence of clinical benefit remain key barriers to implementation. Prospective, multicentre studies are needed to establish whether AI-guided decisions improve management and outcomes.

METHODOLOGY

Study design: Narrative review of AI applications in CRC outcome prediction

Databases: MEDLINE and Embase

Search period: Conducted August 2026; AI studies published in the preceding 10 years. Additional relevant studies were identified by hand-searching reference lists and through authors' knowledge of the field.

Search strategy: Combined terms relating to CRC, adenomas, polyps, AI, machine learning, deep learning, biomarkers, prognostication, survival and patient outcomes

Evidence synthesis: The review included 24 original research studies of AI, alongside supporting literature.

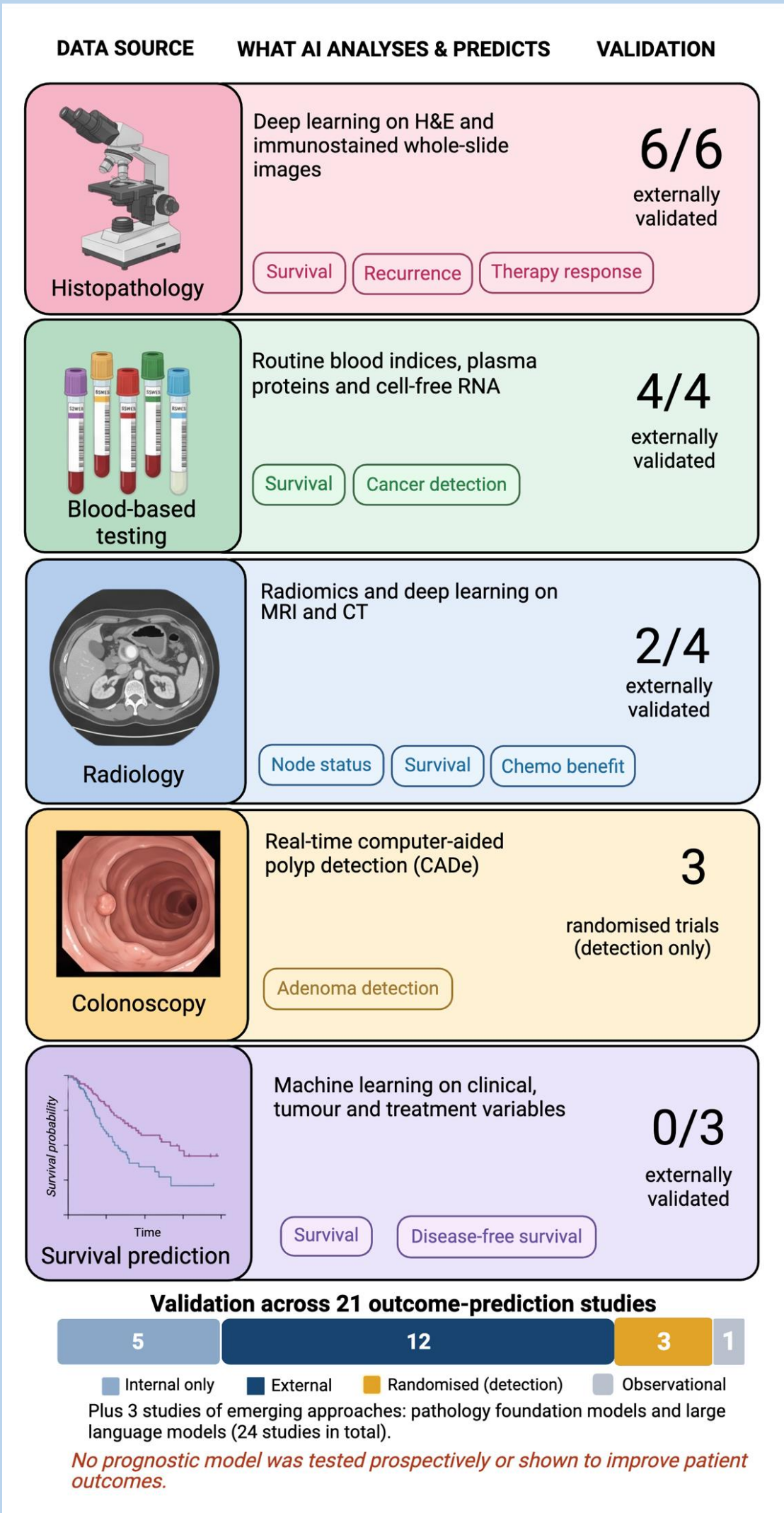


Figure 1. AI applications for predicting CRC outcomes

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Figures: Created in BioRender. Goodall, K. (2026) <https://BioRender.com/hgq8ebn>