A Novel Ensemble Framework for Comprehensive Early-Stage Colorectal Cancer Diagnosis, Prognosis, and Treatment: Integration of Gastroenterology-Specific Transformer Language Models and Multiple Decision Trees

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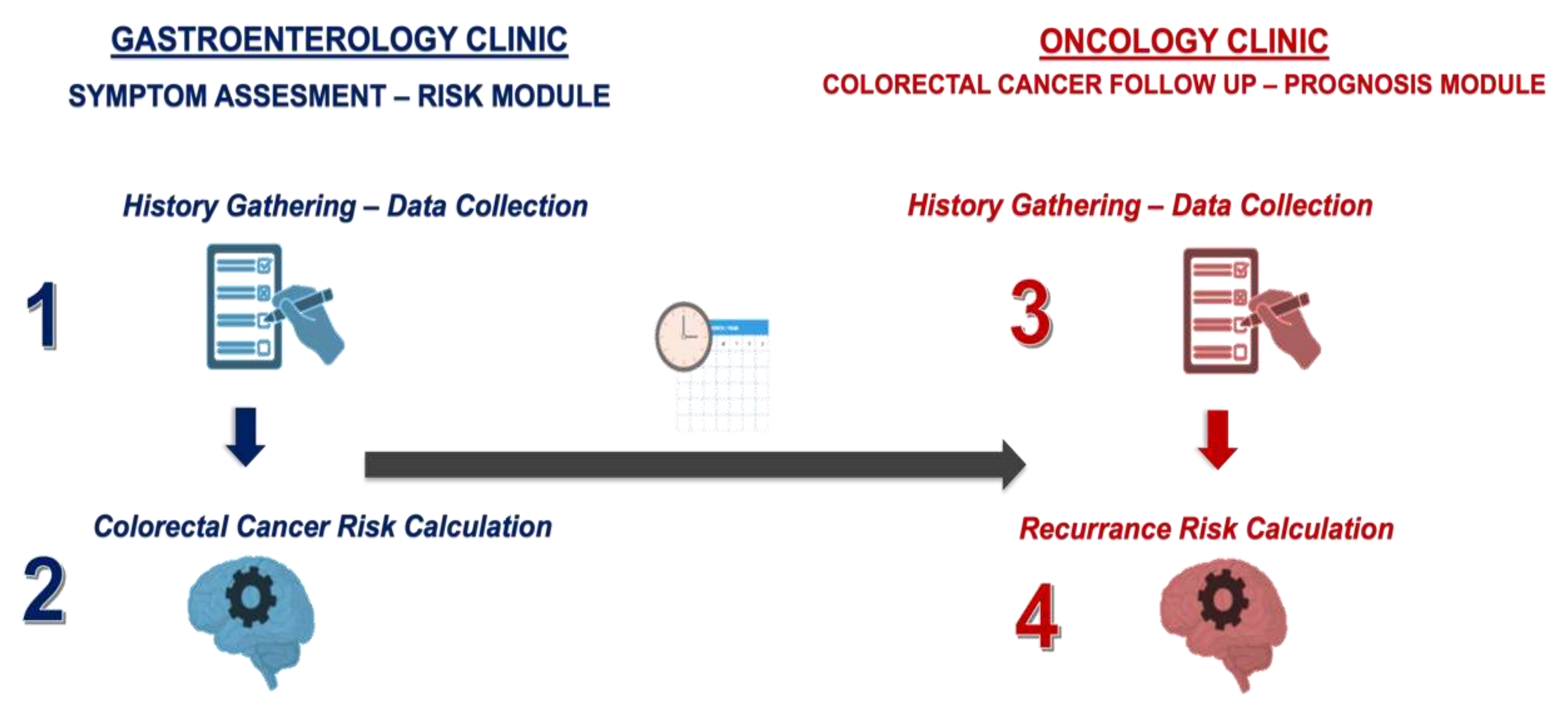
Background: Colorectal cancer (CRC) remains a significant global health burden, with early detection and intervention crucial for improving patient outcomes. This study aims to develop and evaluate a novel proof-of-concept ensemble framework combining transformer-based language models and decision tree-based models for early-stage CRC screening, diagnosis, and prognosis.

Methods: The ensemble framework consists of four key components: (1) GastroGPT, a transformer-based language model for extracting relevant data points from patient histories; (2) A decision tree-based model for assessing CRC risk and recommending colonoscopy; (3) GastroGPT for extracting data points from early CRC patients' histories; and (4) A suite of decision tree-based models for predicting survival outcomes in early-stage CRC patients. The study employed a retrospective, observational, methodological design using simulated patient cases.(Figure 1)

Results: GastroGPT demonstrated high accuracy in extracting relevant data points from patient histories. The decision tree-based model for CRC risk assessment achieved an area under the receiver operating characteristic curve (AUC-ROC) of 0.85 (95% CI: 0.78-0.92) in predicting the need for colonoscopy(Graph 1) . The decision tree-based models for survival prediction showed strong performance, with C-indices ranging from 0.71 to 0.75 for overall survival and disease-free survival at 24, 36, and 48 months(Graph 2).

Conclusion: The novel ensemble framework demonstrates promising performance in early-stage CRC screening, diagnosis, and prognosis. Further research is needed to validate the models using larger, real-world datasets and to assess their clinical utility in prospective studies.

ENSEMBLE COLORECTAL CANCER DIAGNOSIS, TREATMENT AND FOLLOW UP MODULE



GASTROENTEROLOGY CLINIC
SYMPTOM ASSESMENT – RISK MODULE

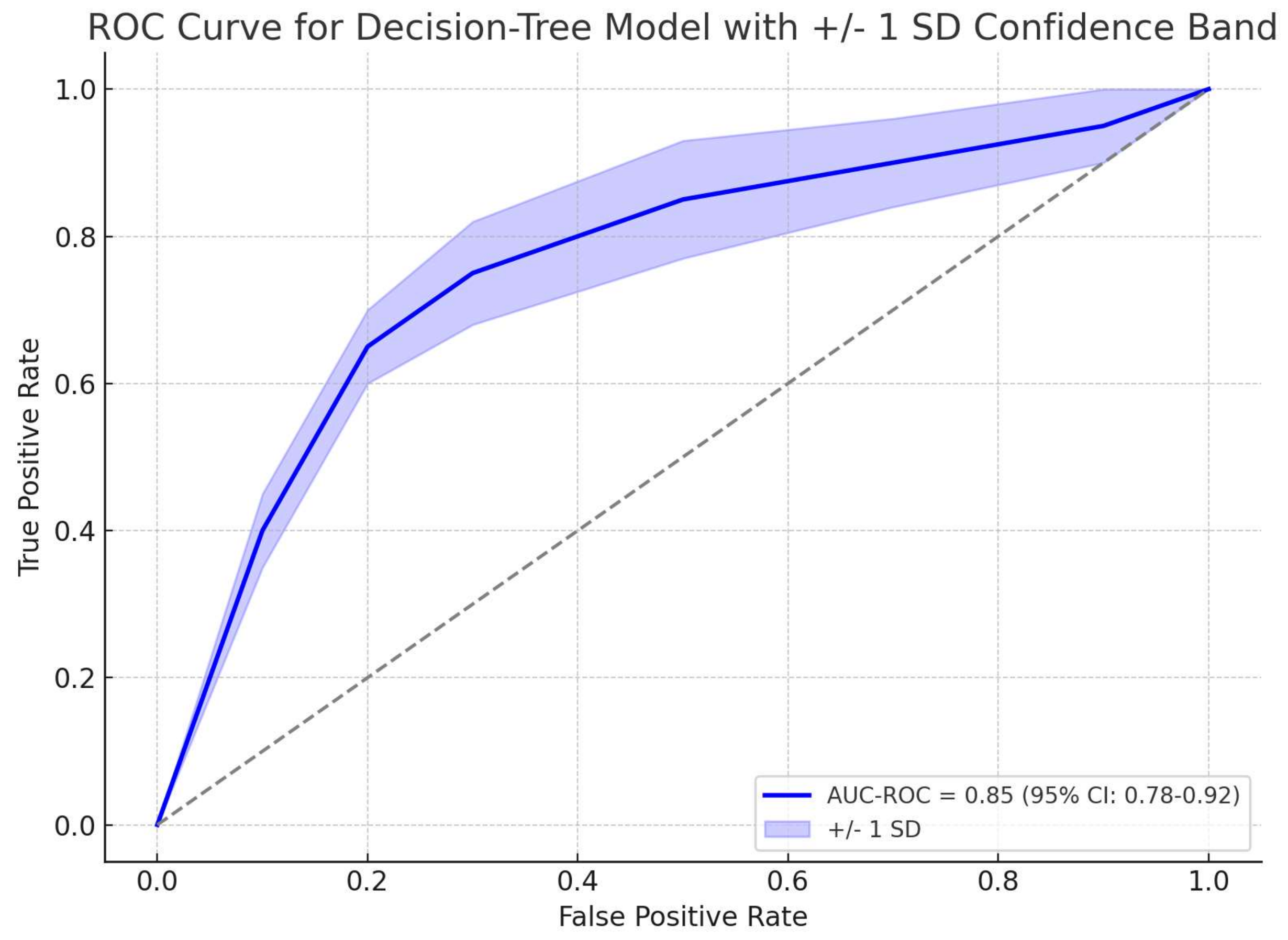
History Gathering – Data Collection
1
Colorectal Cancer Risk Calculation
2

ONCOLOGY CLINIC
COLORECTAL CANCER FOLLOW UP – PROGNOSIS MODULE

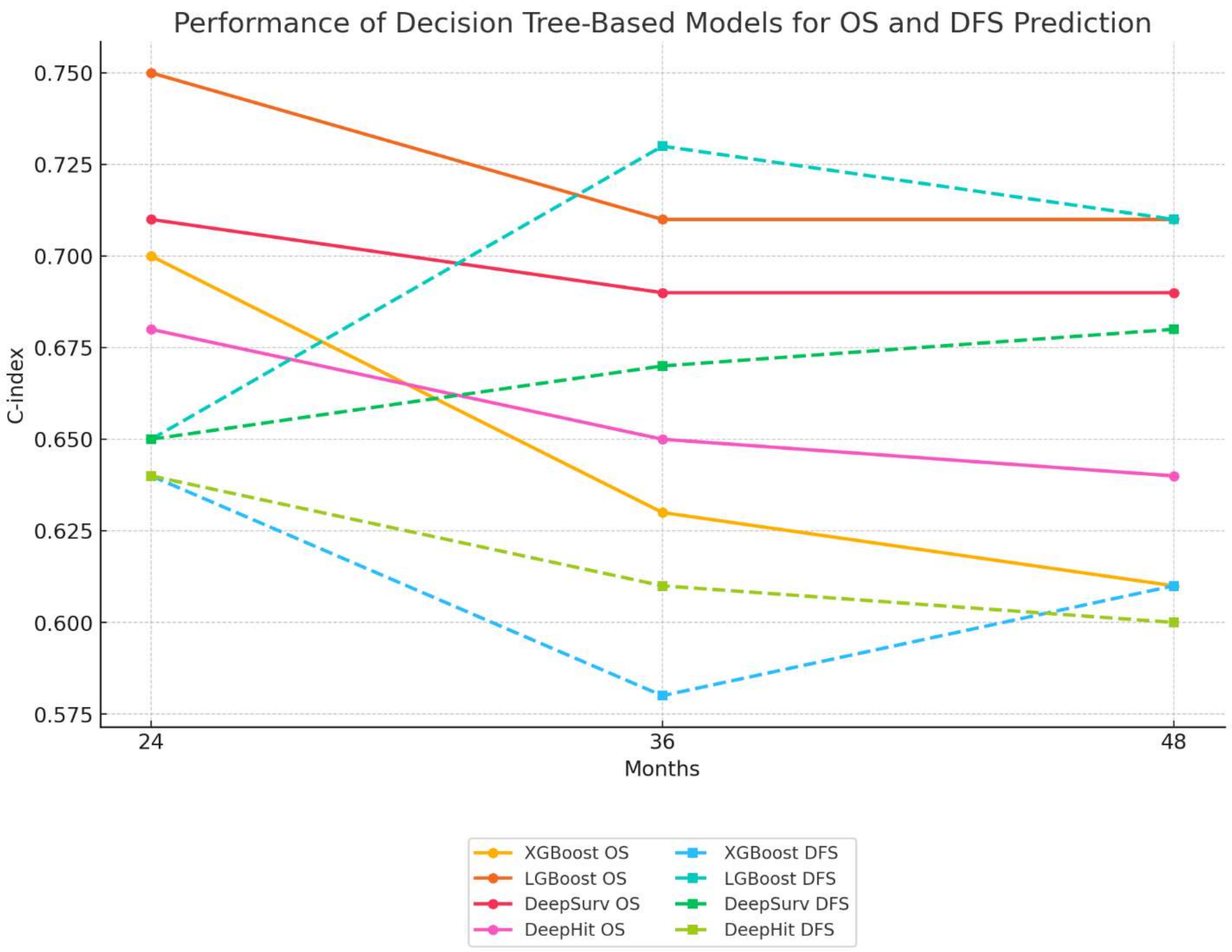
History Gathering – Data Collection
3
Recurrance Risk Calculation
4

Ensemble Colorectal Cancer Diagnosis, Treatment and Follow-up Module

- Gastroenterology Clinic - Symptom Assessment and Risk Module a. History Gathering – Data Collection (Step 1) b. Colorectal Cancer Risk Calculation (Step 2)
- Oncology Clinic - Colorectal Cancer Follow-up and Prognosis Module a. History Gathering – Data Collection (Step 3) b. Recurrence Risk Calculation (Step 4)



Graph 1: ROC curve showing the performance of the decision-tree model in predicting the need for colonoscopy, with an AUC-ROC of 0.85 (95% CI: 0.78-0.92).]



Graph 2: Line graph showing the performance (C-index) of different decision tree-based models (XGBoost, LGBoost, DeepSurv, DeepHit) for overall survival (OS) and disease-free survival (DFS) prediction at 24, 36, and 48 months. (p-values: XGBoost = 0.04, LGBoost = 0.03, DeepSurv = 0.05, DeepHit = 0.07).