Reasons for Biologic Treatment Alteration in Inflammatory Bowel Disease: Insights from Unstructured Clinical Notes Derived from Large Language Models

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BACKGROUND

- Inflammatory Bowel Disease (IBD) is a chronic, relapsing-remitting condition that includes Crohn's disease and ulcerative colitis, affecting over 6 million people worldwide. The disease requires long-term management, often involving biologic treatments to control inflammation, prevent complications, and improve patient outcomes.[1]

- Patients with IBD often experience a range of symptoms that vary in severity, leading to adjustments in treatment plans, including discontinuation or switching of biologics.[2]

- Factors such as adverse drug events (ADEs), financial concerns, and patient preferences are some of the main reasons for changing treatment strategies in IBD management.[3]

- Understanding the specific reasons for treatment alteration is crucial to improving care strategies and patient compliance. Large language models (LLMs) offer a novel approach to extracting meaningful insights from unstructured clinical notes, facilitating deeper understanding of treatment decisions.

OBJECTIVES

- To explore and categorize the reasons behind biologic treatment discontinuation and switching in IBD patients using advanced LLMs, focusing on the following:

  - Identifying patterns in physician documentation

  - Understanding the influence of cost, ADEs, and patient-related factors

METHODS

The two phases involved the use of advanced LLMs, ensuring both precision and adaptability in identifying real-world clinical nuances.

Phase 1: Initial Data Extraction Using Pre-trained LLMs

- Pretrained Model: We employed a pre-trained model from Hugging Face (SQuAD 2.0), which is renowned for its question-answering capabilities in natural language processing (NLP). This model was chosen due to its high performance in accurately identifying specific responses from unstructured texts, such as the reasons behind biologic treatment decisions in the context of IBD.

Phase 2: Fine-tuning with Ground Truth Data

- Model Fine-tuning: After obtaining initial extractions, the model outputs were used to fine-tune a more advanced LLM—Gemini Pro 1.5. This model was selected for its superior performance in handling medical language and its capacity for understanding broader contextual nuances in clinical documentation. The model underwent supervised fine-tuning to increase its precision in distinguishing between overlapping or ambiguous reasons for treatment discontinuation.

RESULTS

- Patient demographic characteristics are summarized in Figure 1:

  - Gender: A slightly higher proportion of females (56%) compared to males (44%).

  - Race/Ethnicity: Most patients identified as White (84%), followed by Black (11%), Asian (2%), and Other (3%). Most patients identified as Not Hispanic (94%).

  - Age: The study population was primarily adults. Most patients were ages 18-64 years (68%), followed by ≥ 65 years (29%), 12-17 years (3%), and < 12 years (1%).
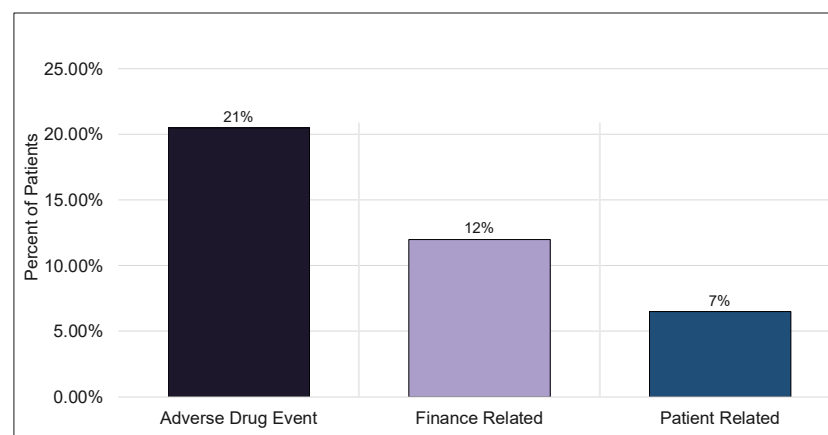
Figure 1: Patient Demographics in Inflammatory Bowel Disease
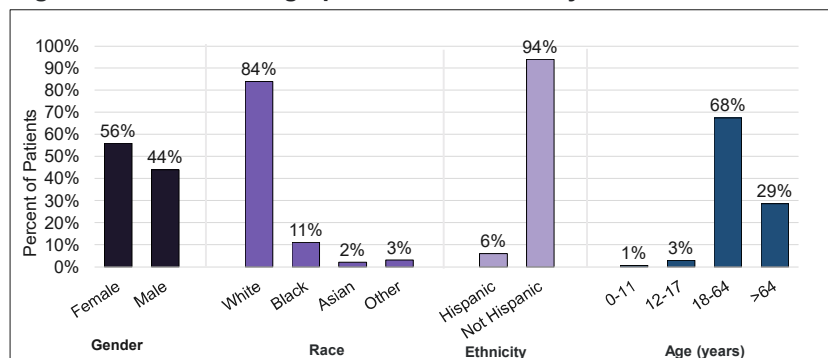
Note: Percentages were based on non-missing data.

- Reasons for discontinuation for infliximab, adalimumab, vedolizumab, and ustekinumab are illustrated in Figure 2, highlighting key factors affecting patient treatment choices.

Figure 2: Reasons for Treatment Alteration Derived from LLMs

- Biologic alteration due to ADEs was 21% (range: 11%-28% across individual biologics).

- Finance-related reasons influenced treatment adherence, which varied from 4-24% (overall: 12%).

- Patient-related reasons were less prevalent than ADEs and finance-related reasons and ranged from 2-9% (overall: 7%).

DISCUSSION AND CONCLUSIONS

- Our study demonstrates the successful use of LLMs, achieving a precision rate of 94.5% in identifying reasons for biologic treatment discontinuation in IBD patients.

- ADEs were the most common reason for discontinuation, and finance-related reasons varied most widely across biologics.

- These insights advance our understanding of treatment challenges in IBD and support the development of more effective, personalized treatment strategies aligning with individual patient outcomes.

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