Jonas Wolber

PhD Candidate

Institute of Digitalization and General Medicine & Institute of Computational Biomedicine Medical Faculty, RWTH Aachen University

[jwolber@ukaachen.de](mailto:jwolber@ukaachen.de)

To the Editors of Journal of Biomedical Informatics

Dear Editors,

Please consider the enclosed manuscript, "Multimodal Large Language Models and Mechanistic Modeling for Glucose Forecasting in Type 1 Diabetes Patients," authored by J.C. Wolber, M. E. Samadi, J. Sellin, and A. Schuppert, for publication in the Journal of Biomedical Informatics Special Issue on *Biomedical Multimodal Large Language Models - Novel Approaches and Applications.*

Our research directly aligns with the special issue's focus on novel methodological work and applications for biomedical multimodal large language models (mLLMs). We present an innovative approach that integrates an mLLM with patient-specific mechanistic modeling and machine learning to improve blood glucose forecasting for individuals with Type 1 Diabetes (T1D). This work addresses the challenge of managing T1D, where predicting glucose fluctuations based on factors like meal intake remains complex.

We used the D1namo dataset, a dataset containing continuous glucose measurement data as well as meal images from T1D patients. We then utilized an mLLM to estimate macronutrient content directly from meal images, reducing the burden of manual logging for patients. These estimations were incorporated into a mechanistic model of glucose metabolism, personalized for each patient using optimized Bezier curves to represent individual metabolic responses to macronutrients and insulin. The outputs of this combined model served as features for a machine learning model (LightGBM) to predict future glucose levels.

Our findings demonstrate that incorporating meal features derived from images via the mLLM significantly improves glucose forecasting accuracy, particularly at longer prediction horizons (60-120 minutes), compared to models without meal information. Furthermore, our method allows for the investigation of individual patient metabolic characteristics, revealing patient-specific responses to different macronutrients. This highlights the potential for more personalized T1D management, including real-time dietary guidance based on predicted glucose responses.

We believe our work contributes significantly to the burgeoning field of biomedical multimodal LLMs by showcasing a novel application that processes visual data (meal images) alongside other clinical data streams. It offers a practical approach to leveraging mLLMs for enhanced, personalized chronic disease management.

This manuscript represents original work that has not been published previously and is not under consideration for publication elsewhere.

Thank you for considering our submission. We look forward to the possibility of contributing to this exciting special issue.

Sincerely,

Jonas Wolber PhD Candidate RWTH Aachen University