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Diabetaid: an AI-driven clinical decision support system for personalised diabetes treatment

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Background and aims: Diabetes is a complex chronic condition requiring personalized treatment. Standard guidelines commonly used often fail to adequately address individual variations. This study aims to develop DiabetAid, an AI-based clinical decision support system (CDSS) providing personalized diabetes treatment recommendations based on comprehensive patient data, including laboratory results and demographics.
Materials and methods: The DiabetAid system predicts personalized treatment combinations represented as binary strings of length 16, corresponding to 16 distinct drug types: Metformin, Sulfonylurea, Glinide, Thiazolidinedione (TZD), Alpha-Glucosidase Inhibitor, GLP-1 Receptor Agonist, DPP-4 Inhibitor, SGLT-2 Inhibitor, Short/Rapid-Acting Insulin, Long-Acting Insulin, Mixed Insulin, Metformin + TZD, Metformin + DPP-4 Inhibitor, Metformin + SGLT-2 Inhibitor, Short-Acting Insulin + Long-Acting Insulin, and Long-Acting Insulin + GLP-1 Receptor Agonist. Treatments are generated by selecting appropriate combinations among these drugs. The dataset used for model development and evaluation consists of 16,655 patient records. To evaluate prediction accuracy, a Custom Jaccard Score was utilized, measuring the similarity between true and predicted treatment combinations. For each position in the binary strings, a matching bit adds 1 to both intersection and union, whereas a differing bit adds 0 to the intersection and 2 to the union. The Jaccard score for each prediction is calculated as the ratio of intersection to union, with the final score being the average of all predictions. Additionally, predictions were reviewed by endocrinologists for clinical applicability, identifying 67 correct and 33 incorrect predictions among 100 evaluated cases. We tested 10 different machine learning models, and the random forest model was identified as the best-performing model based on the Jaccard Score.
Results: The DiabetAid system achieved a high Custom Jaccard Score of 84%, reflecting substantial consistency in recommended treatment combinations. Among various predictive models tested, the random forest model demonstrated superior performance based on the Jaccard Score, indicating its efficacy in accurately predicting personalized treatments. Expert evaluation provided further insights: among the 100 evaluated predictions, 67 were correct with accurate explanations, 19 were incorrect but clinically applicable with correct explanations, and 14 were incorrect, clinically inapplicable, and had incorrect explanations. The model's clinical applicability accuracy based on expert validation was thus determined to be 86%. Furthermore, the incorporation of LIME (Local Interpretable Model-agnostic Explanations) facilitated healthcare professionals' understanding of the rationale behind each AI-generated treatment recommendation.
Conclusion: DiabetAid significantly advances personalized diabetes management, utilizing AI to enhance clinical decision-making. The impressive Jaccard Score and validation by expert endocrinologists underscore the system's capability in providing consistent, clinically relevant recommendations. Future work will focus on model optimization via advanced feature engineering and integrating real-time patient feedback.
Disclosure: **Ç. Akpınar:** None.

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Explainable AI for personalised prediction of adherence to drug therapy in people with type 2 diabetes: a nationwide retrospective cohort

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Background and aims: Poor adherence to anti-diabetic therapy is a major barrier to effective disease management, leading to poorer outcomes and increased healthcare costs. Reasons for poor adherence may differ, and may relate to characteristics of patient, disease, therapy and health care system. We present a novel approach for predicting medication non-adherence in people with type 2 diabetes that combines domain expertise with advanced machine learning to enhance interpretability and explainability.
Materials and methods: We retrospectively analyzed data from Israel's largest healthcare organization. Included were people with type 2 diabetes, who were prescribed at least one oral anti-diabetic medication and had at least two drug purchases between January 2021 and December 2022. Medication adherence was assessed using the prescription-based Medication Possession Ratio (pMPR), with poor adherence defined as pMPR <0.8. Clinical and administrative features were extracted at baseline. Feature grouping - informed by domain expertise - classified features as reflecting patient general health, healthcare utilization, service accessibility, therapy complexity, and self-care, among others. A light gradient boosting machine model was developed to predict poor adherence, and SHapley Additive exPlanations (SHAP) were used to derive feature importance scores within clinically relevant categories. Clustering methods revealed distinct patient profiles based on SHAP-derived adherence patterns.
Results: The study cohort included 207,062 people with type 2 diabetes. Overall, 49.3% were female, 70.7% were Jewish, with a mean age of 67.2 ± 11.3 years and a mean pMPR of 0.74 ± 0.29. The machine learning model achieved an area under curve receiver operation characteristics (AUROC) of 0.86 (95% CI: 0.85-0.86). Clustering revealed nine distinct clusters, with three clusters (Clusters 0, 1, and 2) showing high rates of poor adherence (90.4%, 90.2%, and 81%, respectively). In Cluster 0, the feature with the most dominant negative SHAP effect on adherence was the presence of diabetes-related complications and uncontrolled glucose levels. In Cluster 1, negative SHAP values were primarily driven by socioeconomic factors and treatment complexity, while in Cluster 2, system-level factors and limited healthcare accessibility had the strongest negative impact on patient adherence.
Conclusion: This proof-of-concept study demonstrates that integrating feature grouping with SHAP-derived clustering can identify distinct adherence profiles. This approach may offer valuable insights into the barriers to medication adherence at both the individual and population levels and may inform personalized interventions to improve adherence in people with diabetes.
Disclosure: **M. Kasher Meron:** None.

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Forecasting long-range blood glucose in hospitalised type 2 diabetes patients: a comparative study of predictive modelling techniques

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Background and aims: Artificial intelligence (AI) is rapidly emerging as a powerful tool for personalised medical treatment. When integrated with real-time electronic medical records (EMR), AI can enhance in-hospital diabetes management by accurately predicting blood glucose