PREPARE-Rehab: Personalized rehabilitation via novel AI patient stratification strategies using the OMOP-CDM standard

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Background

Rehabilitation is a complex, person-centered intervention designed to optimize functioning in individuals with disabling health conditions. To support clinicians and patients in the shared decision-making process, clinical decision support systems (CDSSs), such as prediction models, are highly valuable. However, validated prediction models are lacking for many health conditions and outcome domains. Current prediction models are typically developed using simple statistical tools, based on small datasets from a single institution, without external validation. They lack intelligent application programming interfaces (APIs) that allow them to be fed with new data. Moreover, they typically use a custom data model and can therefore not easily be improved or reused when datasets of different origins become available.

PREPARE is a HaDEA-Horizon European project (7 million Euro, 4 years, 20 partners, nine countries), which started in June 2023. In the project we apply machine learning (ML) techniques on nine large-scale rehabilitation datasets. These real-world datasets based on routinely collected data will be analyzed in a federated way. We are developing a platform for sharing model results, exploiting the open-science EHDEN platform and using the Observational Medical Outcomes Partnership (OMOP) Common Data Model (CDM) standard. Prediction and stratification machine learning strategies for rehabilitation data will be validated through nine demonstration pilots of clinical cases.

In this poster we will report on the definition of clinical prediction scenarios, the planning and validation of clinical pilot cases, and the evaluation of the impact on end-users. The results of this work will inform the second phase, in which we will start "OMOPping" as well as building new knowledge around rehabilitation in the ODHSI Community, where a new rehabilitation workgroup has been launched as a spin-off of this PREPARE project. The goals of this group is to establish a network of OHDSI enthusiasts interested in: 1) Sharing and developing knowledge on rehabilitation-specific OMOP-CDM mapping; 2) Discussing rehabilitation-specific data analytic challenges; 3) Stimulating the addition of new OMOP-ed data sets; and 4) Expand the ICF vocabulary for representing rehabilitation measurement and treatment to enable capturing in OMOP-CDM.

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Methods

We defined clinical prediction scenarios and developed the clinical pilot case studies and validation plan. These clinical prediction scenarios, based on the prediction models, inform the development of the CDSSs that are currently under development. The clinical pilot case and validation plan introduce the developed CDSSs of the clinical pilot cases into clinical practice. Firstly, the nine clinical partners listed in detail all variables in their databases: demographics, outcomes, modifiers and measurements. Secondly, they described the interventions in their rehabilitation process in detail, using the Guideline for Interventions Description in Rehabilitation (GUIDE-Rehab) (1). Thirdly, each partner conducted a comprehensive literature review on existing CDSSs pertinent to the health condition in their pilot case. Based on this, they outlined one to four scenarios on how a CDSS could optimize rehabilitation care for their clinical case through patient stratification or outcome prediction. This information was the groundwork for informing the OMOPping process, establishing uniformed vocabulary mapping throughout the clinical pilot cases and identifying absent concepts within existing vocabularies for rehabilitation outcomes and treatments. Comparative analyses were performed of the variables in the various databases, and of the rehabilitation processes.

Results

We collated and reported all the baseline information needed to build the CDSS of each clinical pilot case, such as the rehabilitation process studied, and the databases used to construct the CDSS for each pilot case. We further detailed the nine clinical pilot cases, encompassing population demographics, settings, rehabilitation interventions, and the array of variables captured in their databases, with a particular emphasis on socio-behavioural data. A comparative analysis highlighted both commonalities and distinctions among these clinical cases. Technical partners will leverage this information to develop distinct CDSSs and establish mappings for the data. Furthermore, shared features between the clinical cases facilitate the creation of unified mappings and tools, while differences guide the development of tailored platform components. The latter will lay a robust foundation for incorporating additional health conditions in rehabilitation settings in the future. Finally, we outlined the proposed methodologies to answer the following research questions per clinical case: 1) Would the clinical decisions have changed if the clinician had received the information about the CDSS? 2) How do clinicians experience (adopt and apply) the implementation of the CDSS? 3) How would patients experience the implementation of a specific CDSS in their clinical situation? This deliverable thoroughly informs the future work which will develop the CDSSs and the PREPARE platform, that will be based on the OMOPping of all identified variables. We experienced many variables in our clinical cases that lack appropriate concepts within existing vocabularies, highlighting the need to extend the current library. On the other hand, the overlap in data within the clinical cases provides an opportunity to establish uniform mapping of rehabilitation data. This has been discussed during an OHDSI community call. WHO's International Classification of Functioning, Disability and Health (ICF) provides a framework for developing a new vocabulary and class hierarchy tailored to rehabilitation (2). Additionally, extending the current domains of the Common Data Model (CDM) may improve the mapping of rehabilitation data, including Patient Reported Outcome Measures (PROMs) and long-term treatment. These extensions could significantly enhance the accuracy of data mapping in rehabilitation and beyond. Further, the

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comparison among the different cases will inform the newly developed Rehabilitation ODHSI workgroup.

Conclusions

Exploiting clinical, socio-behavioural and public health research, data science, and advanced statistical and AI learning methods, PREPARE is working to enhance personalized, reliable rehabilitation considering external circumstances and patient factors to improve quality of care and life of people with disabling health conditions. Our findings will help establish best practices for applying OHDSI tools in the field of rehabilitation and help guide the extension of standardized vocabularies and CDM domains to increase its usefulness for applications in biopsychosocial domains.

References

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