



The Integration of Human Intelligence into Artificial Intelligence to Provide Medical Practice-Based Predictions

Chadia Ed-Driouch, Pierre-Antoine Gourraud, Cédric Dumas, Franck Mars

► To cite this version:

Chadia Ed-Driouch, Pierre-Antoine Gourraud, Cédric Dumas, Franck Mars. The Integration of Human Intelligence into Artificial Intelligence to Provide Medical Practice-Based Predictions. Hybrid Human Artificial Intelligence (HHAI) 2022, Jun 2022, Amsterdam, Netherlands. pp.293-294, 10.3233/FAIA220221 . hal-03829412

HAL Id: hal-03829412

<https://hal.science/hal-03829412v1>

Submitted on 26 Oct 2022

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons Attribution - NonCommercial 4.0 International License

The Integration of Human Intelligence into Artificial Intelligence to Provide Medical Practice-Based Predictions

Chadia ED-DRIOUCH ^{a,b,c,1}, Pierre-Antoine GOURRAUD ^{a,b,d}, Cédric DUMAS ^c and Franck MARS ^e

^a *Nantes Université, Nantes, France*

^b *CHU de Nantes, Centre de Recherche en Transplantation et Immunologie, INSERM, UMR 1064, ATIP-Avenir, F-44000 Nantes, France*

^c *Département Automatique, Productique et Informatique, IMT Atlantique, CNRS, LS2N, UMR CNRS 6004, Nantes, France*

^d *Clinique des données, CHU de Nantes, INSERM, CIC 1413, Pôle Hospitalo-Universitaire 11: Santé Publique, Nantes, France*

^e *Centrale Nantes, CNRS, LS2N, UMR CNRS 6004, Nantes, France*

Abstract. The availability of large amounts of medical data, and advances in data science, make artificial intelligence (AI) algorithms the most targeted tool to address the challenge of personalized clinical decision-making for complex diseases. These algorithms exceed the ability of individuals to predict future events in real time from existing data, if the dataset is complete and reflects the entire target population, and the algorithms provide reliable prediction models. However, the process of moving from the data inputs to output decisions is not obvious to a physician. This "black box" problem leads to discomfort, concerns and controversies about the reliability of these models, which limits their adoption [1].

This study aims to enhance the prediction of complex diseases course and promote the adoption of AI-based medical systems.

We propose a new approach based on the development of hybrid predictive models leveraging computational power, good quality medical data and interaction with physicians, especially their intuitive reasoning. This approach integrates the physician in the prediction model creation process, especially in the data preprocessing phase for training the algorithm. Rather than using the raw values of the patient's features and performing auto-clustering by the algorithm, we propose to use a clustering based on the physician's reasoning. Nevertheless, for acceptability reasons, a deep understanding of medical practice is essential to design decision support tools.

We have initiated the application of this new approach to multiple sclerosis (MS) [2]. MS is a chronic disease that affects the central nervous system with a multifactorial pathophysiology and heterogeneous course. Through interactions with MS physicians (interviews, observations) and the literature [3-5], we have identified relevant factors controlling MS course. We converted the factors' values

¹ Corresponding Author, IMT Atlantique, Département Automatique, Productique et Informatique, 4 Rue Alfred Kastler, 44300 Nantes, France; E-mail: Chadia.ed-driouch@ls2n.fr.

in patients' data from a clinical trial dataset (NCT00906399) based on the physician's reasoning. For example, according to the physician, there are three categories of patients for the factor 'disease duration' [D1: <3 years, D2: [3-10], D3: >10 years]. For a patient with 15 years of disease, instead of using the raw value, we use the equivalent group (D3) according to the physician's reasoning. We apply the same data transformation technique for all available factors used by expert physicians and validated in the literature. The converted data are then used as input for the AI algorithm to create a predictive model for MS course. Once the model is validated, we intend to use interactive visuals easily understandable and providing a synchronous communication between the algorithm and the physician. Thus, the latter can adjust the factors (change the type of treatment to propose to the patient, the lifestyle to advise, etc.) until the results reflect her/his medical intent.

This new approach based on physicians' reasoning will increase physician confidence in AI models, and will also contribute to improve the quality of prediction results, as learning data is included in the decision-making process of the medical practice. The use of interactive and easy-to-understand visualizations will facilitate physician-algorithm communication [6] and help to better understand the results provided by the AI model [7]. Hence, boosting the adoption of AI-based medical systems. An implementation of this new approach is in progress to support medical decision-making in multiple sclerosis.

In the future, we expect to compare the results of the prediction based on the physicians' factors with the prediction based on all existing factors in the database. If some factors are found to be important, we will use them in conjunction with the physicians' factors.

Keywords. Hybrid Intelligence, Human-Machine Interaction, Artificial Intelligence, Clinical Decision-Making

References

- [1] Sandhu S, Lin AL, Brajer N, Sperling J, Ratliff W, Bedoya AD, et al. Integrating a Machine Learning System Into Clinical Workflows: Qualitative Study. *J Med Internet Res*. 19 nov 2020;22(11):e22421.
- [2] Yamout BI, Alroughani R. Multiple Sclerosis. *Semin Neurol*. 2018;38(2):212-25.
- [3] Leray E, Moreau T, Fromont A, Edan G. Epidemiology of multiple sclerosis. *Revue Neurologique*. 1 janv 2016;172(1):3-13.
- [4] Kalincik T. Multiple Sclerosis Relapses: Epidemiology, Outcomes and Management. *A Systematic Review. NED*. 2015;44(4):199-214.
- [5] De Stefano N, Stromillo M, Giorgio A, Battaglini M, Bartolozzi M, Amato M, et al. Long-term assessment of No Evidence of Disease Activity in relapsing-remitting MS. *Neurology*. 15 oct 2015;85.
- [6] Flach J, Reynolds P, Duryee L, Young B, Graley J. Digital Healthcare: Moving beyond the data input/out problem toward enhancing clinical judgment. *Proceedings of the International Symposium on Human Factors and Ergonomics in Health Care*. 1 sept 2019;8(1):57-61.
- [7] Habli I, Lawton T, Porter Z. Artificial intelligence in health care: accountability and safety. *Bull World Health Organ*. 1 avr 2020;98(4):251-6.