FUZZY LOGIC METHODOLOGICAL ANALYSIS OF DATA-DRIVEN DECISION MAKING AND ARTIFICIAL INTELLIGENCE MODELLING IN CLINICAL ENVIRONMENTS

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1 INTRODUCTION

The fuzzy research method analytical review is concerned with the methodology of medical decision support systems in both, the area of data collection and management, and the area of their effectiveness, i.e. their ability to provide complex reliability in supporting decisions [1]. The choice of health as a topic is justified by the responsible human aspect, which determines the quality of human life – and often existence – and the availability of a large amount of data for secondary data use, which is massive, long time series and constantly evolving, and which, if used properly, has a crucial impact on the reliability of systems. This data can be further contextualised with other data collected on human behaviour or characteristics of human groups that exist independently of health (e.g. cellular information, global statistics).

Furthermore, the health sector has – with the exception of some countries that are woefully underdeveloped in this area – well-organised institutions worldwide, so that data-driven decision-making processes can be widely verified and implemented in a controlled environment [2], in many cases with the support and cooperation of other (public) institutions (e.g. research laboratories, academic institutions, central repositories).

2 MATERIAL AND METHODS

The institutionalisation of the supporting results of data-driven decision making in the health system can also be established in a manageable way, i.e. all actors involved can adopt and apply the methods and provide feedback on the results achieved within the same regulatory and institutional framework (thus creating a significant potential for improvement/modification).

In clinical decision-making, healthcare professionals often face complex and uncertain situations where data may be incomplete, subjective, or imprecise. For example, interpreting symptoms, estimating disease progression, or evaluating treatment effectiveness. A Fuzzy research method offers a robust approach to model such ambiguity and vagueness, especially when integrating human expertise with data-driven systems.

The Prisma research methodology could provides a structured framework to examine the available literature, facilitating a nuanced survey on how deep could data-driven decision make a public health supply more predictable but we have choosen the fuzzy logic research method, because it provides a valuable extension to data-driven clinical decision-making by incorporating flexibility, uncertainty modeling, and human reasoning into the system.

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Its hybrid integration with data science tools enhances the interpretability and reliability of AI-powered systems in critical healthcare scenarios [6].

Another advantage of healthcare systems is the continuous – practically daily – feedback and, just as important, the mandatory filling in of new data content during examinations, so the system‘s self-learning capacity is also strong, which means that it is also advisable to use algorithms that can change dynamically [3].

In this research, the authors focus on input-output data and demonstrable results, as well as on the different areas of application. The importance of the latter is that data-driven decision making does not seem to be equally effective in all areas and, accordingly, there are areas of data collection and processing methods that have a higher reliability in supporting decisions, so a deeper analysis of these methodologies is warranted and desirable to extend them to other areas. In terms of methodologies and challenges, the research will also look at different structures and solutions in order to identify key benchmarks and best practices, but also gaps.

The most important markers of data-driven decision modelling in health care are the saving of lives and the preservation of a good quality of life with optimal use of resources – human, financial, equipment. The totality of these parameters – not only because of their complexity – cannot be comprehended by the human mind, therefore the ability of data-driven decision support systems to support these parameters in real-time is of great importance. However, the systems do not make the responsible decision, but support it, so the last word is still in the hands of the human decision.

3 RESULTS

As a result of a deep and extensive literature search, the most widely used methods for determining decision thresholds [4] in the literature have been identified: decision theories can also be grouped according to their nature as descriptive, normative (essentially the same as expected utility theory), and prescriptive. While descriptive and prescriptive theories offer an alternative approach to reality as opposed to normativity, many decision threshold theories [5] combine them.

The study concludes that these theories need further research. In discussing the theories, almost all theories are described in the literature as a combination of some other theory(s), their role in the actual threshold training process, and certainly the analysis of practical decisions supports this. In practice, decisions are not made on the basis of ‘pure theories’, and it is therefore the combined or combinable methods that are most likely to be suitable for describing and supporting them.

A shortcoming of the research is that it does not even mention the literature that also uses decision thresholding methods for adaptive algorithms, because this allows to describe the decisions of a dynamically changing environment more reliably and to establish the self-learning process. When a decision threshold is fixed as a static parameter, the system is switching off the possible self-learning part of the system. If the algorithms can dynamically apply the decision paradigms themselves, we can get even closer to the practical.

4 CONCLUSIONS

The creation and operation of data-driven decision support systems and artificial intelligence for clinical practice is a complex, innovative, rapidly evolving, multidisciplinary process. The effectiveness of existing systems also needs to be measured by a number of difficult-to-quantify parameters to ensure that the models are effective. The setting up of data-driven decision making and artificial intelligence models, the expectations of patients and physicians, the quantity and quality of the data analysed, the decision thresholds, the operational practices of users, all have a complex impact on patient and care safety and the

reliability of decision support. Conscious and continuous development of models, complex testing, control of their biases, adaptation and verification in new areas, complex data asset management contribute to the practical effectiveness of models.

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