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EDITORIAL

Greece 2.0, Health Economics and Outcome Research and the Rise of Artificial Intelligence: Another Missed Opportunity or it's Time for Brilliance?

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Abstract

The EU National Recovery and Resilience Plan "Greece 2.0" includes, among other priorities, a framework to promote and reform the health system, with a focus on digitalization of health and the use of information technology applications. Greece 2.0 may offer a chance to address the current scarcity of high-quality, reliable data sources, which is limiting the spread and impact of health economics and outcomes research (HEOR). We also suspect that the use of artificial intelligence (AI) in HEOR will play an important role in Greece's health-care reform and that it will be critical for making real-world data-driven decisions, reducing policy uncertainty. Greece has a once-in-a-lifetime chance to start from scratch and potentially build data-centric AI systems that prioritise data quality over quantity and are built on scalable, flexible, and governable data collection. This commentary explains and critically considers the significance of developing and funding an innovative plan for using AI in HEOR as part of the Greece 2.0 framework. It also discusses ethical issues and the larger role of HEOR in health-care reform.

Keywords: Greece 2.0, Health Economics and Outcome Research, Artificial Intelligence, Healthcare Reform

1. Introduction

Greece's sovereign debt crisis, which began in 2009, forced the government to review its overall spending priorities and efficiency as this was requested by the "troika," a group formed by the

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European Commission, the European Central Bank, and the International Monetary Fund. Greece's health care system was suffering from several inefficiencies, including but not limited to unequal and inefficient allocation of human and economic resources; an anachronistic retrospective reimbursement system creating incentives for supplier-induced demand; limited digitalization; and the absence of a health technology assessment (HTA) committee (Petmesidou, 2019; Economou et al., 2017; Kentikelenis et al., 2011).

The Greek government initiated significant reforms in the healthcare sector with the goal of enhancing spending efficacy and structural aspects of the system, including the establishment of a HTA committee aiming to provide policymakers with evidence to inform decision-making (Kalavrezou & Jin, 2021). However, in Greece's case, they were too much, too fast and, in many cases, in the wrong direction, distorting the principle of equity. Large-scale data strategies have been applied in the healthcare system because of the ever-increasing amount of data, which is essential for better healthcare delivery. Existing data management designs for healthcare systems provide difficulties in controlling crises, despite the adoption of big data analytic methodologies and systems. Data sets can be aggregated on a massive scale, human capital choices can be supported, and healthcare organizations' efficiency can be measured at a reasonable cost thanks to big data analytics. In order to boost efficiency across the health care system, the decision-making process zeroed in on Big Data analytics in healthcare organizations. This included defining the most valuable Big Data analytics that can aid in decision-making for healthcare leaders and offering a number of potential solutions (Efthymiou et al., 2020a).

There is still no preparedness for the impact of the measures adopted on health and the health system, and timely response to these effects is absent. Scientific evidence is becoming more and more important to accurately assessing the outcomes of policies as reform programmes grow. Greece in 2022 officially filed its first request for the disbursement of 3.56 billion euros in the framework of the National Recovery and Resilience Plan "Greece 2.0", becoming the first country in the European Union (EU) that satisfied all relative landmarks and goals, including a legislative framework to promote and reform the health system focusing on the digitalisation of health and the use of information technology (IT) applications. The government has great expectations that the uptake of IT innovations in health care will contribute to improved efficiency and quality of health care as well as improved clinical and health outcomes. The adoption of artificial intelligence (AI) in health economics and outcomes research (HEOR) is expected to play a big part in Greece's health care reform and will be important for making decisions based on real-world data (RWD). AI can potentially revolutionise health care in

all its facets, including research, data analysis, and policymaking. However, as for most other types of IT innovations, the uptake of AI in health care is still at an early stage. There are some challenges like privacy, data biases, etc. in the use of AI in the healthcare field (Dash et al., 2019; Maddox et al., 2019; Yu et al., 2018).

The goal of this article is to explain and think critically about the importance of establishing a plan for the use of AI in HEOR as part of the Greece 2.0 framework. This is a step that needs to be taken in order to reform and create a sustainable and effective national health system.

2. Greece 2.0 and Artificial Intelligence

Greece, as a member of the European Union, has recognised the importance and the potential of AI, as well as the possible challenges and risks, and thus aims to foster a technology-enabled future. The Greece 2.0 framework aims to bring technological advancements, including AI, into the public administration for the purposes of efficient data processing. Currently, the Hellenic Ministry of Digital Governance (MDG) is in the final phase of shaping its national strategy on AI, including specific priorities and actions, data policy and ethical rules, and involves major stakeholders and experts from within the country and the EU. A large proportion of the €300 million investments announced by the Greek pharmaceutical industry will focus on technologies such as AI and big data analytics for the development of new drugs. However, there is no clear central vision for AI adoption in the public health sector, HTA/HEOR, or new technology research and development.

3. The Role of HEOR in Greece's Health Care Reform

HEOR is a growing applied research field that provides important information for making healthcare coverage and access decisions, focusing on whether treatments work in the populations they serve and how much of the cost of health technology should be reimbursed by the healthcare system (Liang et al., 2014; Holtorf et al., 2012). In Greece the limited HEOR and the lack of a well organised centralised mechanism to assess health technologies contributed to possible overpricing of drugs, medical equipment, and materials in hospitals (Kalavrezou & Jin, 2021).

Health economics has thus attracted more attention in recent years in Greece, while an increasing amount of HEOR literature has been published related to this local context. Local recommendations for health economics research that include specifics on methodologies and best practices in pharmacoeconomic evaluations would lead to improved policymaking and play a crucial role in advancing reform initiatives. The absence of high-quality, credible data sources currently limits the

expansion and impact of HEOR. Longitudinal databases that integrate inpatient, outpatient, and pharmacy resource consumption as well as clinical outcomes are highly sought after but have yet to be produced. However, as part of Greece 2.0, the Greek government has begun digital foundation reforms in health that will be carried out for at least the next decade. This includes initiatives such as the development of the individual electronic health record, the digital upgrade of the Greek National Health Service Organisation (EOPYY), the digital upgrade and interoperability of hospital units, the creation of a central repository for diagnostic tests, the development of oncology digital records, and so on.

The digital transition in the health sector is based on the utilisation of RWD. This data is collected concurrently with the service delivery and health management processes at the patient level and is collected through prospective or retrospective research methods. The processing of RWDs creates documentation based on real-time data known as real-world evidence (RWE), which includes strict methodological rules for validating data quality, standardization, and analysis, as well as protecting the right to privacy (Khosla et al., 2021). This real-world "big data" era represents an exciting opportunity to utilise powerful new sources of information to reduce clinical and health economic uncertainty at an individual patient level (Zou et al., 2020; Pastorino et al., 2019). In turn, HEOR practices will need to evolve to accommodate individual patient-level analyses needed to inform healthcare decision-making that is tailored to highly specific patient clusters or individuals (Chen et al., 2016). Therefore, the problem of transforming RWD into RWE is becoming increasingly important, and AI could be a possible next-gen solution.

The evolution of AI over the years has been stagnant, but it has not met health researchers' expectations as they evolved. More international and local research is needed to figure out how to get around the practical limits of AI software and methods, and efforts should be made all the time to make the AI tools better. As Efthymiou et al. (2020b) mentioned, AI will improve physicians' perspectives, freeing them up to dedicate more time on patient care and operations. Recently, AI technology has been promoted as one of the primary technologies enabling a significant improvement in the delivery of healthcare and related services. Artificial intelligence is developing tools to aid with, and even eliminate, the arduous process of healthcare administration, which includes everything from diagnosing patients to coordinating their treatment. If the most pressing problems can be resolved in the near future, it will play a pivotal role in the future of healthcare administration, the expansion of clinical capital, and the guarantee of the best possible patient results.

4. Artificial Intelligence and HEOR

There is a massive gap between what AI actually is in reality and how the media and general public perceive AI. Strictly speaking, it can be argued that AI is not "intelligence" while it's not "artificial consciousness". AI should be considered an advanced and more complex type of algorithm. AI is defined broadly as the simulation of human intelligence processes by machines, particularly computer systems. Again, this is not to say that AI could replace human intelligence and human critical thinking patterns. It comes as no surprise that several research studies have been conducted to examine the use of AI in healthcare and determine whether it is safe to use on both humans and animals. However, considering that AI requires computers and robots to essentially "act," "react," and interpret data like humans, there are a variety of ethical issues that could arise. AI still needs human interaction, which might cause problems, even if it depends on technology, machines, and math to function. Furthermore, AI models might be incorrect, just like any other digital health technology, posing dangers to patient safety.

These problems can be caused by several things, such as issues with the data used to create the algorithm, the decisions made by the programmers while creating and training the model, and how the AI-enabled software ultimately implements all functions requiring human intervention (Murtha et al., 2022). The decisions of AI are not always intelligible to humans. Humans have the intrinsic capacity to think, reason, review, and adapt to new situations by combining a variety of cognitive processes and abilities that are necessary in health research. Through information and frequent training, AI can acquire knowledge, but it will never develop a human-specific thinking process or critical thinking. Further, AI is subject to biases and hence prejudice. Numerous examples from the real world have shown how biases in algorithms may lead to injustice in terms of gender, racial origins, or skin colour (Short, 2018; Obermeyer et al., 2019). Biased AI might, for example, result in incorrect diagnoses and make treatments ineffective for specific sub-populations, endangering their safety.

This is especially true in the healthcare field, where phenotype-and occasionally genotype-related information is involved. Consider, for example, AI-based "clinical decision support (CDS)" software that enables medical professionals to choose the most effective course of action for patients with "skin cancer." The algorithm, however, was primarily trained on patients who were Caucasian. As a result, the AI software will probably provide less accurate or even incorrect suggestions for sub-populations like African Americans, for which the training data was not sufficiently inclusive. Increased data accessibility, efforts to better gather data from minority communities, and clearer articulation of which populations the algorithm is or is not fit for usage may help to address some of these biases. However,

the complexity and lack of transparency of several algorithms remain problems (Gerke et al., 2020). In the health industry, the use of AI to capture, amalgamate, standardize, and analyse RWD is still evolving. It has the potential to support the increased use of RWE to improve global health and healthcare.

This automation and AI-powered data analysis features relieve the burden of repetitive work, allowing for greater focus on what really matters, which is essential, time- and cost-effective in HEOR. At the moment, AI is incapable of replacing HEOR researchers and, in no sense, is able to replace the complex nature of decision-making. However, the fast analysis and implementation of real-time world data will help to decrease uncertainty in policy making. Because of this vast amount of uncertainty and subjectivity in the research process, including biased assumptions in economic models' policy making has become challenging and risky. Using the COVID vaccines' efficacy of nearly 90% in a laboratory setting as an example, we observed in the real world, collecting RWD, that this high outcome did not translate to effectiveness, and thus an efficacy trial can overestimate a vaccine's impact in practice due to the inability to count for external patient-, provider-, and system-level factors (Singal et al., 2014). This restricts the outcomes of a trial to representing real-world outcomes in order to generate the parameters required by economic models.

This means that additional studies should be conducted throughout the technology's lifecycle, from trials to RWD, which is not an easy task given the need to use sophisticated methods to efficiently analyse large amounts of healthcare data (Lu et al., 2021). By applying innovative methods to large volumes of healthcare data, AI and its applications such as machine learning (ML) have the potential to generate real breakthroughs in both HEOR and patient care and management. A recent paper examines the potential opportunities for employing AI in HEOR, matching four well-established AI applications, including natural language processing, text data analysis, machine learning, and deep learning, to the most common forms of HEOR research activity. Researchers emphasise the importance of improving the quality of healthcare information systems and data, as well as training researchers and policymakers on these approaches and applications (Padula et al., 2022). But there is no published advice on how to report AI-powered models in the HEOR field at the moment.

5. Golden Opportunity to Start from Scratch

The lack of digital data in Greece presents a golden opportunity to start from scratch and potentially create data-centric AI systems that prioritise data quality over quantity based on a set of data that is scalable, adaptable, and governable (Patel et al., 2022). Technologically advanced and developed

economies, such as the United States, Germany, Canada, and the United Kingdom, have achieved the digitalization of health and the collection of RWD, but are now facing significant challenges in transforming their systems and making them time-efficient and accessible to AI systems. Instead, they use AI applications such as deep learning to structure unstructured data, with the goal of eventually using data analysis AI systems. This implies that they could take an additional step in using AI, sacrifice existing data or spend significant resources, including time, on the analysis of complex data.

Only recently, the British NICE published an evidence standards framework aimed at ensuring that evidence generated today meets the system requirements of tomorrow, with a focus on AI. This framework makes it clear that good data practices are essential to creating high-quality data-driven digital health technologies (NICE, 2022). Consider a researcher's workstation, which is cluttered with thousands of unlabelled printed articles and is attempting to implement a systematic review. This review is still possible, but it will take time and extra effort, and the quality of the research output may suffer as a result. Consider how much easier this review will be if the researcher uses software to organise the downloaded papers in a suitable format. The same applies to AI. Using complex unstructured and errored data from multiple resources is viable, but it requires complex AI systems that should be tailored to the needs of the data as well as a significant amount of time and resources.

Simply put, Greece should not pass up the opportunity to establish a health data system that can be easily adapted for the application of AI. This means collecting the right type of data in the right format, increasing its quality, and securely granting access to it. making the creation of an evidence standards framework vital for the future. This is critical since the accuracy and fairness of AI algorithms are entirely reliant on the data they are given. Another challenge that should be considered is the user-friendliness of IT systems in the procurement process of data collection systems and favour intelligent systems that flag-up errors in real-time. Since AI technology has the potential to seriously threaten patient privacy, safety, and preferences, these promising new ethical concerns must be understood and addressed (Rigby, 2019). For example, when using AI to diagnose or cure illnesses, massive volumes of data and more data exchange will be required. The US Health Insurance Portability and Accountability Act (HIPAA) may be invoked as a result, raising possible privacy and security concerns. This will require that developers adopt the appropriate HIPAA Security Rule policies, Privacy Rule, processes, and technological security measures. The likelihood of a data breach or the re-identification of de-identified data sets grows as more data is introduced to AI systems, especially when more complex AI enables the linkage of data (Murtha et al., 2022). It is advantageous to quickly incorporate AI technology into the healthcare system since AI offers an opportunity to improve the

effectiveness of healthcare delivery and the standard of patient care. However, considerable effort has to be made to establish the right ethical framework for integrating AI technology into healthcare securely and productively (Murtha et al., 2022).

HEOR field data should be accessible and, in terms of user-friendliness, also for research institutions or private businesses such as HTA consultancy services. It is evident that proper data collection is a crucial and unique task as Greece should innovate considering that there is no similar system in other countries to mimic. Producing AI-oriented data is time-consuming and expensive as there is a lack of ready-to-apply knowledge in an international context. Greece 2.0 funds provide a significant opportunity to invest in this. This will be achievable if non-profit research organisations, innovative IT businesses, and national universities collaborate on multidisciplinary research projects centred on data-centric AI systems in the field of health. This creates an opportunity not only to innovate within the EU, but also to prevent brain drain, which is also a significant issue in Greece. With the development of the appropriate data exploitation strategy and the adoption of AI technology, Greece will be able to become a global centre of excellence in the collection and analysis of RWD/RWE and become a pole of global attraction for research funds, having HEOR as the centre of practice. AI has the potential to change many facets of patient care within the provider, payer, and pharmaceutical industries. By making such a plan, it will be easier to build a digital data analytics ecosystem, which will help the economy of the whole country.

6. Conclusions

We believe that AI has an important role to play in the health reforms of the future. Adopting AI in health reforms is a challenging project, and given the obvious hype surrounding it, there is reasonable scepticism about AI's ability to revolutionise health care. Considering that AI can be a key part of the health-care reform story, there is a need for a central governmental vision for AI adoption in the public health sector considering the importance of HTA/HEOR. Greece 2.0 provides a great opportunity to develop health care to become more information-driven, individualized, and scalable through the implementation and use of AI systems. AI will allow for the fast analysis and implementation of real-time world data, which will help to decrease uncertainty in policy making. It also seems increasingly clear that AI systems will not replace human research efforts and capabilities from critical thinking on a large scale, but rather will augment their efforts to make complex tasks feasible and time efficient. A proportion of Greece 2.0 funds should be invested in the use of health care, policy, and research to bridge the gap between theory and applied use of this technology. Despite the fact that this is an

exciting era, we need to be cautious when determining how much value AI really adds. Rigorous conceptual frameworks and empirical implementation studies of AI in the health field are needed.

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