



## Greek reflections on global neurosurgery

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### ARTICLE INFO

#### Keywords:

Disparities  
Global neurosurgery  
Greece  
Health equity  
Neurosurgical care  
Refugee

### ABSTRACT

**Introduction:** Large populations in middle- and low-income countries in Africa, Asia, and Central and South Americas face a dramatic neurosurgical crisis. However, large social groups in high-income countries face similar limited access to neurosurgical services. Proper identification of such a problem, analysis of the underlying causes, and proposal of potential solutions may not only address the problem at a national level, but may also provide valuable reflections on the efficient management of global neurosurgical crisis.

**Research question:** To evaluate if special social groups face similar problems in Greece.

**Material and methods:** The structure of the Greek health system was examined. The national census along with the registry of practicing neurosurgeons of the Greek National Society, as well as the national health map were searched.

**Results:** A series of socio-economic factors, language barriers, cultural and religion differences, geographical barriers, the COVID-19 pandemic aftermath, along with the inherent malfunctioning of the Greek health system have led to this national neurosurgical crisis.

**Discussion and conclusion:** An extensive redrawing of the Greek health map, reorganization of the national health system, along with adaptation of all recent advances in telemedicine may alleviate the health burden in these populations. The results of this local reformation may be applied to a global level for managing the ongoing health crisis. Moreover, the development of a European taskforce by the European Association of Neurosurgical Societies (EANS) may well facilitate the development of realistic and efficacious global solutions, and contribute to the global effort for providing high-quality neurosurgical services worldwide.

### 1. Introduction

The concept of making neurosurgical care available to people around the world has gained tremendous popularity during the last few years (Fuller et al., 2020; Rosseau et al., 2020; Maleknia et al., 2022). Recently, there is an increasing number of efforts, originating mainly from the USA and Europe, focusing on humanitarian neurosurgical missions for providing immediate relief to the existing neurosurgical demands (Marchesini et al., 2022). Furthermore, many initiatives have been developed on providing international fellowships and educational grants for training young neurosurgeons from developing countries, on collaborative clinical programs between well-established and growing medical schools, and also on redistributing resources and neurosurgical equipment to low-income countries. It is clearly stated by the World Health Organization (WHO) that all people should have equal access to high quality health services independently of where they live, what their ethnicity, or their financial or social status is (World Health Organization, 2020). However, it is apparent that this WHO declaration constitutes

mostly a utopia rather than a realistic situation. Indeed, the disparity between the provided neurosurgical services in the developed and the developing countries is astonishing. Access to organized neurosurgical facilities may be routine for citizens of high-income countries, but this is not the case for most of the middle- or low-income countries (Meara et al., 2015). This is mostly attributed to the shortage of practicing neurosurgeons, the existence of organized medical facilities, the emergent medical transportation system, and the available resources dictating in many cases that where one lives may determine whether one lives (Dewan et al., 2018).

Thus, North America, most of Europe, and a few Asian high-income countries provide to their residents a health system, in which neurosurgical emergencies and elective procedures for degenerative diseases may be safely managed. Although this geographical distribution of available neurosurgical care is supported by the relevant data, a closer look at the situation in many European countries reveals intense discrepancies. These exist not only between different countries within Europe, not only between different geographical regions (industrialized North versus

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agricultural South), but also between different social groups within the same country.

In our current communication we analyze the situation of neurosurgical practice in Greece, with emphasis on the deficiencies of the provided neurosurgical care to certain social groups and to populations of particular geographic areas of the country. We outline the contributing factors and conditions that have formatted the current situation, as well as their consequences on the Greek Neurosurgery. We also attempt to provide suggestions, which may blunt the discrepancies of the provided neurosurgical care to different social groups in Greece. The wider accessibility along with the improvement of the provided neurosurgical services in Greece may well serve the concept of acting locally while thinking globally. The reformat of the neurosurgical, applicable to all medical, services across European countries may well be a paradigm for global implementation. Indeed, such national projects may provide valuable knowhow and practical solutions to the development of efficient global initiatives. Furthermore, the continuous effort for actual improvement of the current health systems of high-income countries will be more convincing to governmental health agencies and the people of low-income countries about the true motive of any global neurosurgical project.

## 2. Methods

The structure of the Greek health system was examined. The most recent national census, and the registry of practicing neurosurgeons of the Greek Neurosurgical Society, as well as the national health map of the Ministry of Health were searched. Moreover, the two most recent annual reports (2020 & 2021) of Insurance Europe, the European insurance and reinsurance federation, were examined for extracting data regarding the private insurance data for the Greek population.

Our findings have been organized into a section providing a brief description, and also identifying the unique characteristics of the Greek health system, and especially of the neurosurgical services. The impact of contemporary financial and social parameters in the national health system is also presented in Section 3.

Furthermore, a set of proposals is presented for alleviating the existing Greek health system problems, as well as the effect of such a reformat of the national health system to the global neurosurgical map (Section 4).

## 3. Greek neurosurgical reality

### 3.1. Health system and demographic changes

The Greek health system has two components: a public National Health System (NHS), which is theoretically accessible from all permanent residents or legal visitors of Greece, and a private system, which is supported by private hospitals and clinics, exclusively located in large cities. These private hospitals are available only to patients insured through private insurance companies or to patients paying directly to the hospital. The most recent annual report (2021) of Insurance Europe demonstrated that approximately 2.4 million people had private health insurance coverage in Greece (Hellenic Association of Insurance Companies, 2021). This percentage is significantly lower than the average European private insurance coverage, and definitely significantly lower than the respective in the Netherlands, Switzerland, Luxemburg, Slovenia, and Belgium, which represent the first five European countries in the premiums per capita list (Insurance Europe and Statistics, 2020).

It has to be taken into consideration however, that access to the NHS may be impossible or compromised to illegal immigrants/refugees, whose number is exponentially increasing, due to the recent geopolitical situation in the Eastern Mediterranean. Characteristically, in 2019, there were 186,000 refugees and asylum seekers in Greece according to the official data of the United Nations refugee agency, while 5000

unaccompanied children were among them (UNHCR The UN Refugee Agency, 2020). The official data however under-represent the actual magnitude of the problem, since there is a large number of illegal immigrants, which cannot be accurately evaluated. In addition, the existent language barrier further compromises access to the health system for all these immigrants, and makes seeking of even basic health care quite challenging. This results into significant delays in the management of even neurosurgical emergencies. Moreover, religious and cultural differences further compromise access to the health system, especially for women and children. The vast majority of the immigrants are gathered in refugee camps located in the eastern part of the country, on the islands, in which there are no neurosurgical centers, and management of complex neurosurgical conditions may be quite problematic and time consuming.

Certain social groups such as elderly people, people with disabilities, with dementia, or with chronic comorbidities, may have ambulatory difficulties, which may result in compromised neurosurgical care. This situation becomes of importance, since the geriatric population will be increasing within the next decades, as well as their associated morbid conditions, intensifying thus the current problem. Unfortunately, the recent Covid-19 pandemic further intensified the isolation of all these groups, making even more problematic the seeking of any neurosurgical care (Lytras and Tsiodras, 2022).

### 3.2. Greek health system unique characteristics

Certain, unique geographical conditions constitute another major barrier for accessing proper neurosurgical care. Greece has more than 227 inhabited islands among a total of approximately 6000 islands in the Aegean and Ionian seas, while at the same time there are several mountainous areas, of high altitude and difficult terrain, in which emergent transportation can be quite challenging, rather delayed, and occasionally impossible due to forbidding weather conditions (Fig. 1). This unique physical geography, which does not constitute a problem for the vast majority of western and central, continental European countries represents an obstacle for easy access to neurosurgical services. This may cause prolonged delays in the management of neurosurgical emergencies for the residents of these areas, requiring lengthy road or boat trips, or frequently air-vac transportation, which is extremely demanding, if even feasible, and especially during the night. Moreover, a simple neurosurgical consultation requires a patient to travel frequently for many hours, resulting in losing a large amount of working hours, income, and unaffordable traveling expenses. All these lead to postponement of seeking neurosurgical evaluation, which frequently results to complex neurosurgical conditions, requiring more extensive and costly management in the long run.

The recent pandemic and its aftermath have also had a dramatic, negative effect on the Greek NHS. The subsequent hospital's resources decrease, the relocation of health personnel, and the accumulating physical and mental strain of the hospitals' staff resulted into massive cancelling or postponement of elective neurosurgical procedures, and prolongation of the already long surgical waiting lists. It has to be pointed out that the average waiting time for a restorative cranioplasty in our academic institution approximates ten months, for an elective degenerative spinal procedure exceeds six months, while for functional cases, such as DBS or VNS implantation, this is more than 12 months. But even for subacute conditions, such as an intracranial glioma, the waiting time is 4–8 weeks, while for a pituitary tumor this is more than three months, with potential medico-legal implications. It needs to be kept in mind that the impact of the pandemic was even worse in the Greek NHS. This was the result of the previous economical crisis affecting the country immediately before the pandemic, without providing sufficient time for fiscal recovery (Tzerefos et al., 2021). It has to be taken into consideration that the national gross domestic product (GDP) was -4.3% in 2009, -5.5% in 2010, -10.1% in 2011, and -7.1% in 2012, indicating the pre-pandemic dismal financial situation in Greece (The World Bank, 2021). These



Fig. 1. Geophysical map of Greece outlining the extensive mountain areas and the numerous islands.

detrimental effects are still influencing the public health system, and are more prominent in surgical subspecialties, including neurosurgery. Prolonged waiting in the Emergency Room, delayed performance of CT scan and other imaging tests afterhours, total inability to perform MRI or digital angiography afterhours or during weekends/holidays, represent common problems for the vast majority of the chronically understaffed, public hospitals.

The situation of neurosurgical services becomes even more perplexing due to the imbalanced distribution of practicing neurosurgeons in Greece. The majority of neurosurgeons are located in big cities, leaving a large proportion of the country underserved. It is characteristic the fact that the analogy of neurosurgeon per population is 1 neurosurgeon per 25,065 residents for the Athens metro area, 1 per 33,120 for Thessaloniki and Central Macedonia, 1 per 88,516 for Eastern Macedonia and Thrace (the country's eastern border), 1 per 59,640 for Thessaly and Central Greece, 1 per 85,099 for Peloponnese and Western Greece, and 1 per 88,516 for Crete (Hellenic Statistical Authorities, 2021; Hellenic Neurosurgical Society Archives, 2022).

It has also need to be pointed out the fact that many advanced neurosurgical treatments are provided exclusively, or almost exclusively, in private hospitals. It has to be emphasized that only 22.6% of the Greek population has some form of private health insurance, percentage significantly lower than the average European. Until recently, stereotactic radiosurgery or endovascular treatment was provided, only in private medical centers in Athens or Thessaloniki. This was a forbidding

factor for indigent or low-income patients to access this kind of treatment. Unfortunately, the recent, prolonged, financial crisis has significantly increased the number of unemployed or low-income patients, making thus their proper neurosurgical management quite problematic. Along with all these conditions the chronic, self-perpetuating Greek bureaucracy has to be taken into consideration. This may be accountable for prolonged emergency room delays, inefficient communication between physicians of public hospitals, unnecessary transfer of patients from peripheral to referral hospitals, and performance of repetitive, excessive diagnostic tests. These may confound diagnosis, delay proper treatment, and unreasonably increase the overall health cost. Additionally, the outdated organization of the Greek NHS, which obsessively ignores new transportation conditions, and connections through a rapidly developing national motorway system, further compromise neurosurgical care for a large percentage of the Greek population. In 2007, the Greek government divided the country in to seven health regions (Fig. 2). (Hellenic Republic, 2022) Their intention was to plan, coordinate, supervise, and control all health service providers (Hellenic Republic, 2022). As a consequence, every Health Region superintends numerous regional hospitals, as well as a central, referral hospital. Often the referral hospital is a University hospital. According to this operational plan, a patient from Desfati, facing an emergency neurosurgical problem, has to be transported to a referral hospital in Thessaloniki (219 km) instead of a referral hospital in Larissa (80 km) (Fig. 3).



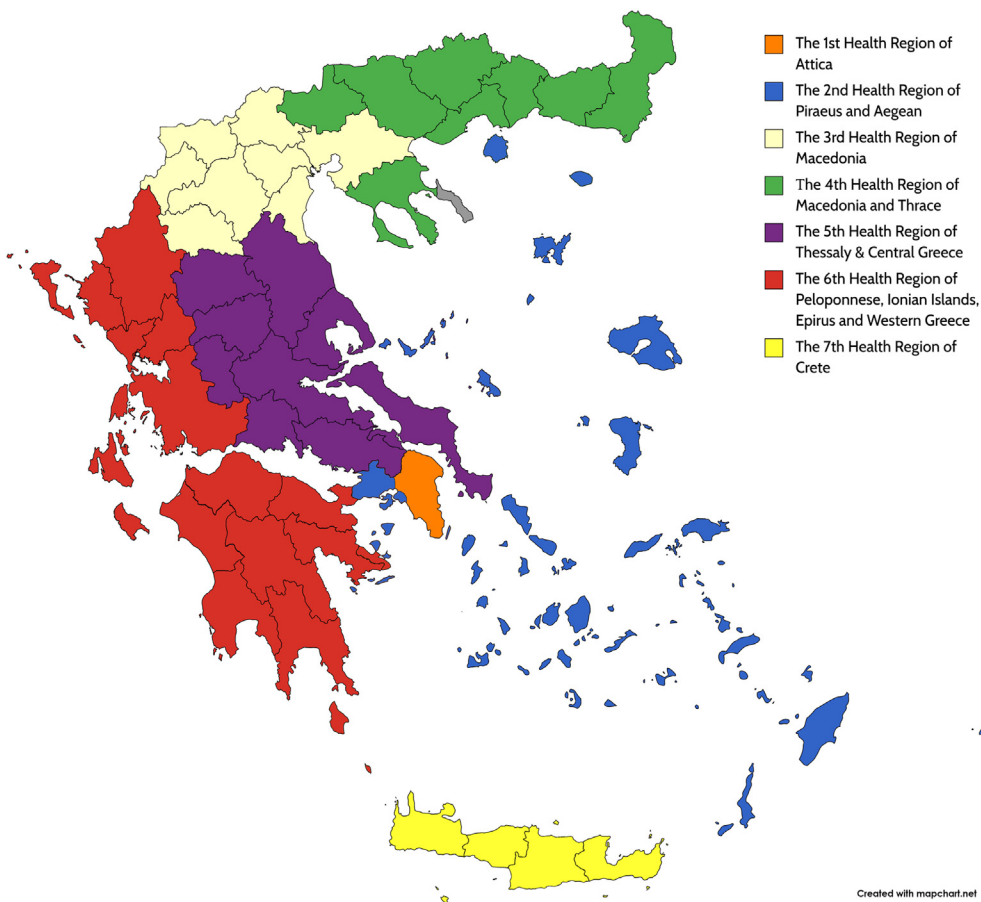


Fig. 2. Map showing the current division of Greece into seven health regions.

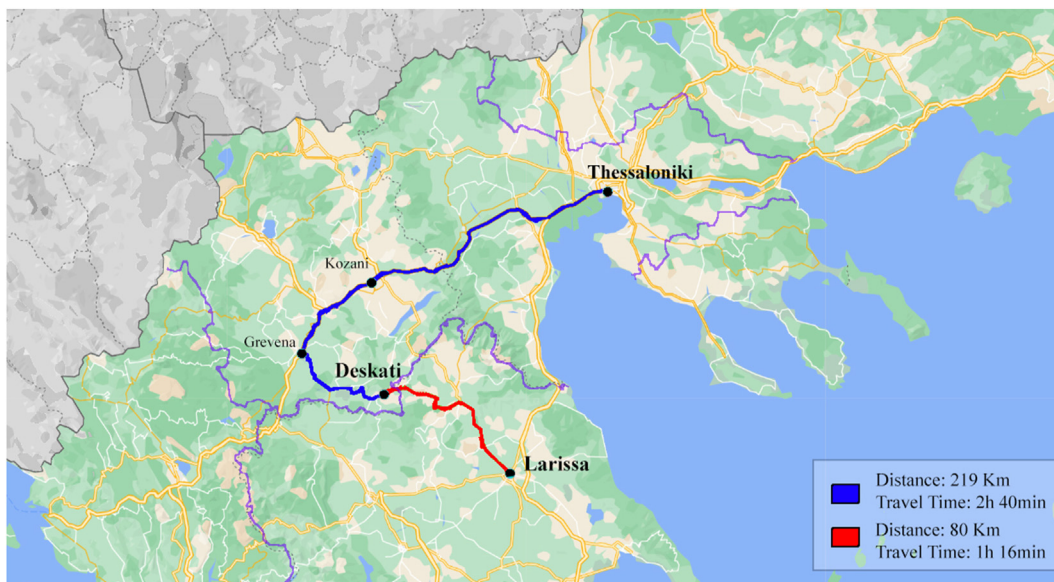


Fig. 3. Map of northern Greece depicting the borderline town of Deskati, according to the health region division (the purple line represents the health region borders). This is a characteristic example of the current irrational neurosurgical operational system. It is noteworthy, that a patient from a borderline town must travel a significant longer distance for neurosurgical management, causing unnecessary delays. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

## 4. Proposals for alleviating the problem

### 4.1. National proposed solutions

A solution to this perplex problem would require a series of measures and actions for drastically changing the Greek health landscape. The redesigning of the current health map seems to be an essential step towards a viable solution. The redivision of the country into health regions has to take into account the rapidly evolving national road system, as well as the newly developed sea and air transportation networks, instead of the traditional geographical and/or administrative compartmentalization. The existence of a referral, tertiary neurosurgical facility in the heart of each of these emerging health regions would guarantee proper management of neurosurgical cases in a timely fashion. This would also create high-volume neurosurgical centers with apparent improvement of the provided neurosurgical services, and with balanced catchment areas, based on the new, rapidly evolving demographical data. These neurosurgical facilities would attract young neurosurgeons, who could practice in a protected collegiate, and thrive within a secure scientific environment. The cost of the redesigning process will not be forbidding, since the break-even point will be reached within a few-month period.

The redrawing of the Greek health map should be accompanied by a project of developing a fast and reliable telemedicine network. This will secure rapid diagnosis and proper and efficient management at the referring hospitals (primary or secondary) by emergency medicine and/or trauma physicians. Apparently that requires the encouragement of medical graduates for taking these specialties, with a series of initiatives and rewards. Expectedly, the rate of unnecessary transportations of neurosurgical patients will be diminished, and their management will be immediate and proper. Furthermore, the patients and their families will be close to their homes, decreasing thus wasting of working hours and income. The development of short-stay observational units in these referring facilities may further decrease the overall management cost.

### 4.2. European proposed solutions

A medical school core curriculum reshaping is of great importance in the implementation of this health system reformation. The new medical demands induced by the rapid social changes, and the upcoming geriatric tsunami, cannot be managed without properly modifying and adjusting the medical school curriculum. The development of programs promoting public health into these special social groups, along with projects of education for avoiding head and spinal cord injuries, may progressively diminish the health system burden. Likewise, designing of initiatives minimizing the incidence of developmental nervous system anomalies through better perinatal care will ensure better cost effectiveness. This should be accompanied by systematic governmental efforts for integrating or re-incorporating these special social groups into the society.

Redistribution of resources and support of neurosurgical centers in currently underserved areas may also create the conditions for locally managing these patients, in a timely fashion. The establishment of neurosurgical facilities at the eastern part of Greece, the southernmost part of the eastern European frontiers, seems to be more than imperative, for serving the constantly increasing number of refugees/illegal immigrants. Initiatives and rewards may drive young or established neurosurgeons to practice in these underserved areas. It has to be emphasized that this is not a unique Greek problem, since many eastern European countries face similar problems after the invasion in Ukraine.

Moreover, the designing of all these changes requires thorough knowledge of the neurosurgical demands, the unique characteristics of neurosurgical practice, and the available neurosurgical human resources. The concept of act locally and implement the produced knowhow to a global level may well be an efficient way of tackling the problem of global neurosurgery. These national European health system reformats may provide practical, easily applicable, solutions to many low- and middle-income country health issues. The active involvement of the national

neurosurgical societies and the European Association of Neurosurgical Societies (EANS) is mandatory for developing realistic and efficacious solutions. The past has demonstrated that the development of managing plans by administrators or even physicians without meticulous knowledge of the neurosurgical reality has led to disappointing and costly failures. The development of a common European taskforce, taking into consideration special national characteristics and parameters, may well serve this purpose.

## 5. Conclusions

A thorough and frank evaluation of the current Greek neurosurgical reality demonstrates that seeking of neurosurgical care may be a modern Odyssey for many people residing in Greece. Unfortunately, the exponentially increasing number of people having no or limited access to the NHS, makes the management of this problem imperative. After all, the concept of global neurosurgery may not be a distant project, but rather a domestic, European one. Tackling and solving this problem at a local level may well provide insights on efficiently managing the ongoing, world neurosurgical crisis.

## Funding

This study did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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