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# ANALYSIS OF MEDICAL RESOURCES IN EUROPEAN COUNTRIES

# ANALIZA ZASOBÓW MEDYCZNYCH W KRAJACH EUROPEJSKICH

# АНАЛИЗ МЕДИЦИНСКИХ РЕСУРСОВ В ЕВРОПЕЙСКИХ СТРАНАХ

**Abstracts**

*One of the important elements in determining the level of social development of the country and the quality of life of its inhabitants is an appropriate availability of medical resources. Access to medical resources differs across Europe. The goal of the present article is to analyze the availability of medical technology and the hospital technical resources as well as the diagnostic and treatment procedures performed in hospitals and ambulatory providers. The article analyses data from the EUROSTAT on the state of health care physical resources and their utilization in selected European countries, for which data are available, for the period 2008-2013. The comparisons are focused on three subject areas: medical technology, technical resources in hospitals, examinations by medical imaging techniques. The problem of availability of medical resources is shown on the background of the average for the analyzed countries.*

***Keywords:*** availability of medical resources, medical technology *and equipment*, hospital technical resources.

**Streszczenie**

*Jednym z istotnych elementów wpływających na poziom rozwoju społecznego kraju i na jakość życia jego mieszkańców jest odpowiednia dostępność zasobów medycznych. Dostęp do zasobów medycznych różni się poszczególnych krajach europejskich. Celem niniejszego artykułu jest analiza dostępności technologii medycznych i zasobów technicznych w szpitalach, a także procedur diagnostycznych wykonywanych w szpitalach i ambulatoryjnych jednostkach ochrony zdrowia. Dane wykorzystane w analizie pochodzą z bazy Eurostatu i dotyczą okresu 2008-2013. Przeprowadzona analiza porównawcza dotyczy trzech następujących obszarów: technologii medycznych, zasobów technicznych szpitali, procedur diagnostycznych wykonywanych przy użyciu analizowanych zasobów. Problem dostępności zasobów medycznych jest pokazany na tle średniej arytmetycznej obliczonej dla analizowanych krajów.*

***Słowa kluczowe:*** *dostępność zasobów medycznych, sprzęt i technologie medyczne i sprzętu,zasoby techniczne szpitala.*

***Аннотация***

*Целью данной статьи является анализ доступности медицинских технологий и технических средств в больницах, а тоже диагностических процедур, выполняемых в больницах и организациях амбулаторной медицинской помощи. Данные, используемые в анализе взяты из базы Евростата за период 2008-2013 годов. Сравнительный анализ применяется к следующим трем направлениям: медицинские технологии, технические ресурсы больниц, диагностические процедуры, которые осуществляются с использованием технических ресурсов. Проблема доступности медицинских ресурсов показана на фоне среднего уровня, рассчитанного для стран по которым проводится анализ.*

***Ключевые слова:*** *доступность медицинских ресурсов, медицинская технология и оборудование, технические ресурсы в больницах.*

**Introduction.** The most important task of health care system is its efficient functioning that enable to improve the health state of the population. It is possible thanksof existing medical resources, experienced medical staff and the organizational structure [A. Winiarczyk – Raźniak 2010]. One of the important factor that determine the level of social development of the country and the quality of life of its inhabitants is an appropriate availability of medical services.

The availability of medical services depends in great measure on the amount of technical resources and medical technology in a health care system of the country. Medical technology is broadly defined as all the drugs, devices and medical and surgical procedures and the organizational and support system used to provide them [Office of Technology Assessment, 1976]. Particularly important is the widespread availability of medical equipment. It affects many important aspects of life (the state of public health, mortality, life standard) and the social development of the country. Appropriate availability of the technical resources in the country based on the needs of its inhabitants is therefore one of the most important problem that has to be solved by the contemporary health policy [Włodarczyk 1996].

1. The availability and utilization of medical equipment

In the literature, physical resources are often referred to a health system infrastructure and technology/ equipment and they provide the material platform for the delivery of health care services. They represent a significant investment for the health sector, which is constantly increasing, reflecting technological progres [O. Adams 2003, p.13].

One of the most important indicators of the physical resources in the health care system is the number of medical equipments. It allows to assess the ability of the health system to ensure sufficient number of medical services. The medical equipment includes various kinds of equipments which are regularly main tained and staffed and immediately available for the care of patients admitted to hospitals and other providers of ambulatory health care providers. Developments in medical technology allows to offer selected services, not only in hospitals, but also in community clinics, mobile health units and even in patients' houses [R. Rosen 2002].

Developments in medical technologies impact on medical diagnosis and treatment. X-rays were discovered in 1895 and it started to be common for medical diagnosis of internal organs and body structures.

The technological progress enabled to introduce the various other diagnostic devices gamma cameras (1950), PET scanners (1960) and medical MRI equipment and CT scanners(1970). There are quite high differences in the number of medical equipment per 10,000population in various European countries (Figure 1 - 6). Indicator of the number of medical equipment per10,000 population is calculated by the following formula:

$$B_{PI} = \frac{NB_t}{NI_t} * 10{,}000$$ where:

$NB_t$ - number of medical equipment in the year t

$NI_t$ - number of inhabitants in the year t

In the Eurostat health database, only large technological devices are monitored, such as: CT Scanners, Magnetic Resonance Imaging Units, Gamma cameras, PET scanners, Radiation therapy equipment, Mammo graphs, Angiography units, Lithotriptors. First six types of medical technology are imaging equipment used for diagnosis, while last two are for treatment. These data are available for only few years for more or less number of UE countries.

In order to analyze the availability of medical equipment in hospitals and providers of ambulatory health care, the following indicators were calculated [EUROSTAT, 2015]:

Computed tomography scanners (CT) – it is an x-ray machine which combines many x-ray images with the aid of a computer to generate cross-sectional views and, if needed, three-dimensional images of the internal organs and structures of the body (Fig. 1).

Magnetic resonance imaging (MRI) - it is an imaging technique designed to visualize internal structures of the body using magnetic and electromagnetic fields which induce a resonance effect of hydrogen atoms. The electromagnetic emission created by these atoms is registered and processed by a dedicated computer to produce the images of the body structures. (Fig. 2)

Mammographs (MM) – the mammography machines designed exclusively for taking mammograms (Fig. 3).

Angiography units (AU) - it is a device using the technique that combines a dynamic picture (obtained after contrast injection) with a static picture taken before contrast injection. Subtraction of these pictures creates an accurate image of the cardiovascular system. (Fig. 4). Gamma cameras (GC) - it is a device used for a nuclear medicine procedure in which the camera rotates around the patient to register gamma rays emission from an isotope injected to the patient's body. The gathered data are processed by a computer to form a tomographic image. (Fig. 5).

PET scanners – it is a highly specialised imaging technique using short-lived radioactive substances. This technique produces three dimensional images which are used mainly for the assessment of cancer spread in a patient's body (Fig. 6).

Two types of medical technology, such as Lithotriptors and radiation therapy equipmentwere not presented in this article because they were generally less commonly available in analyzed countries.

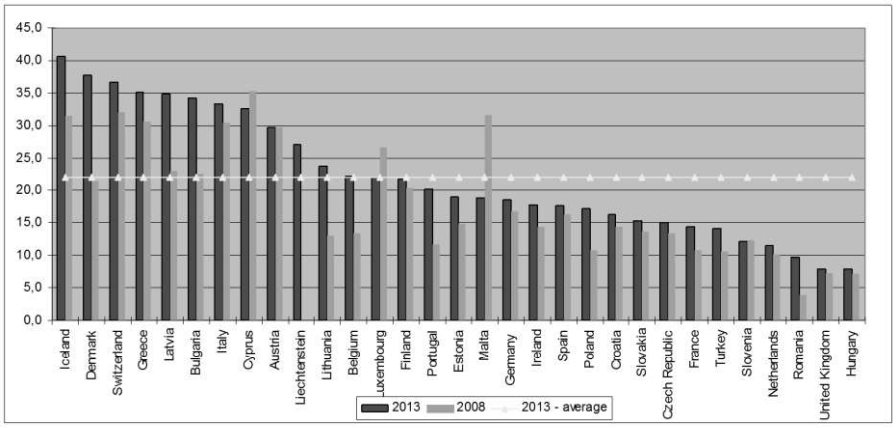
The figures below demonstrate the differences in resource profiles of different European countries based on MRI, CT scanners, PET scanners, Gamma cameras, Mammographs and Angiography units per 10, 000 population according to the data from 2013 and 2008.

The analyzed data regards equipment in hospitals and in ambulatory health care facilities. For some countries, e.g. Belgium, Germany and Portugal, the data only cover the availability of this equipment in hospitals.

In 2013 the highest value of the CT ratio was recorded in Iceland (40.5), Denmark (37.8), Switzerland (36.6), Greece (35.1), Latvia (34.8), Bulgaria (34.3). The lowest ratio was observed in Hungary, United Kingdom (7.9) and Romania (9.7). In Greece, most CT and MRI scanners are installed in privately-owned diagnostic centres, and only a minority are found in public hospitals. Between 2008 and 2013, the availability of CT scanners increased by at least 10 units per 10, 000 inhabitants in Liechtenstein, Denmark, Bulgaria, Latvia and Lithuania. Only in Malta, Luxembourg, Cyprus, Slovenia and Austria this ratio fall over the period under consideration. It happened mainly due to increases in thepopulation but also because of a reduction inthe absolute number of CT scanners (only in the cases of Malta and Luxembourg).

Among the European countries, the highest value of the MRI ratio in 2013 was recorded in Liechtenstein (27), Italy (24.5), Greece (24.2), Finland (22.1) and Iceland (21.8). On the other hand, the lowest ratio was recorded in Hungary (3.0), Romania (4.4), United Kingdom (6.4) and Poland (6.1). Since 2008, the largest

creases in the availability of MRI scanners per 10, 000 inhabitants were recorded in Finland and Lithuania (by more than 6 MRI units per 10, 000 inhabitants). None country reported a decrease over this period for this ratio.

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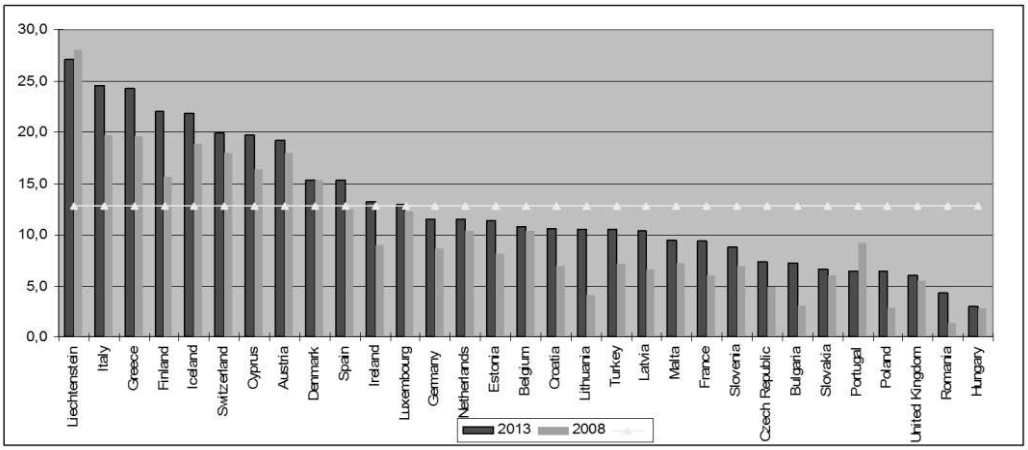
Source: own work based on data from EUROSTAT

Figure 1. Computed Tomography Scanners per 10, 000 population in selected European countries in 2013 an 2008

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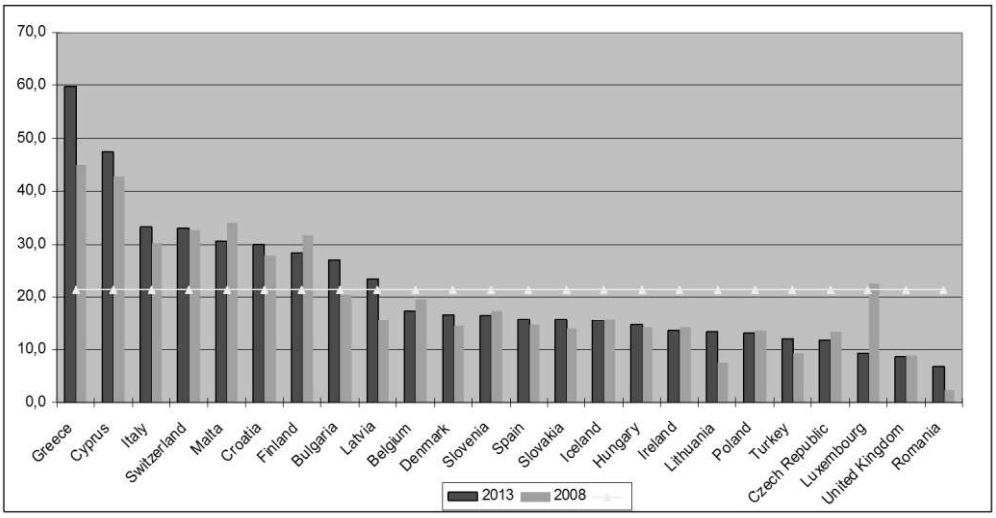
Source: own work based on data from EUROSTAT

Figure 2. Magnetic Resonance Imaging Units, per 10, 000 population in selected European countries in 2013 and 2008

Among the European countries, the highest value of the MRI ratio in 2013 was recorded in Liechtenstein (27), Italy (24.5), Greece (24.2), Finland (22.1) and Iceland (21.8). On the other hand, the lowest ratio was recorded in Hungary (3.0), Romania (4.4), United Kingdom (6.4) and Poland (6.1). Since 2008, the largest increases in the availability of MRI scanners per

10, 000 inhabitants were recorded in Finland and Lithuania (by more than 6 MRI units per 10, 000 inhabitants). None country reported a decrease over this period for this ratio. The availability of CT scanners and MRI units has increased rapidly in most EU countries over the past decade. During the last five years the highest positive percentage change of MRI ratio was recorded in Romania (223%), Lithuania (151%), Bulgaria (132%) and Poland (119%). The highest positive percentage change of CT ratio was recorded in Romania (84 %) and Denmark (76%).

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Source: own work based on data from EUROSTAT

Figure 3. Mammographs per 10, 000 population in selected countries in 2013 and 2008

The highest value of MM indicator in comparison to the values observed in other countries was noted in Greece. In 2013 it was 59.8 mammographs per 10,000 population and it was 33 percent more comparing the level recorded in 2008 (44.9). On the second place in 2013 was Cyprus (47.6), and on the third one - Italy (33.4). The lowest indicator was in Romania (6.8), Estonia (8.3) and in United Kingdom (8.6). In most of the EU countries, there has been a significantly higher value of this indicator in 2013 compared to 2008. The decrease of the number of mammographs per 10,000 population was observed in Luxembourg, Finland, Czech Republic and in Malta. The highest increase of this ratio was recorded in Greece (by 14.8 units per 10,000 inhabitants) and in Latvia (by 7.9 units per 10,000 inhabitants).

Generally, higher numbers of modern diagnostic equipment, such as gamma cameras or angiography units are found in better developed countries. The country which recorded a highest number of angiography units relative to population size in 2013 was Switzerland (29 units per 10,000 inhabitants), followed by Lichtenstein angiography units was recorded by Romania (27 per 10, 000 inhabitants) and Finland (18.6 per 10,000 inhabitants). The lowest ratio for angiography units was recorded by Romania (2.8 per 10, 000 inhabitants). Between 2008 and 2013, the availability of angiography units increased in most countries for which data are available, only decreasing in Malta, France, Luxembourg, Belgium and Finland.

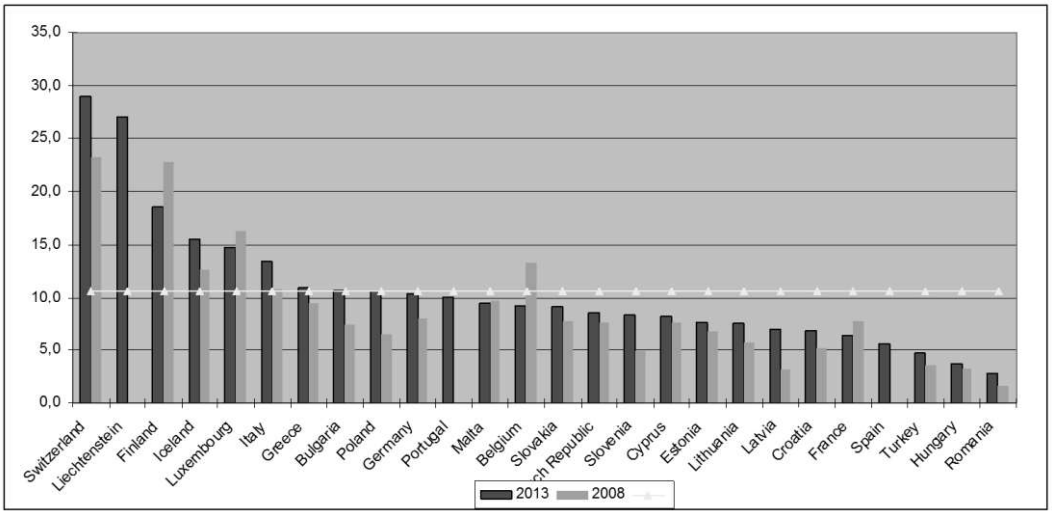


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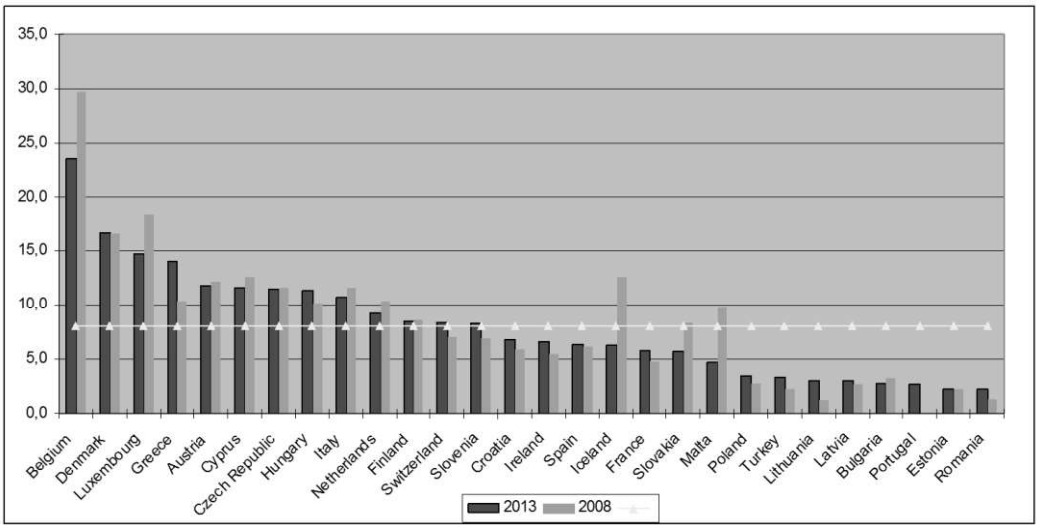
Figure 4. Angiography units per 10, 000 population in selected countries in 2013 and 2008

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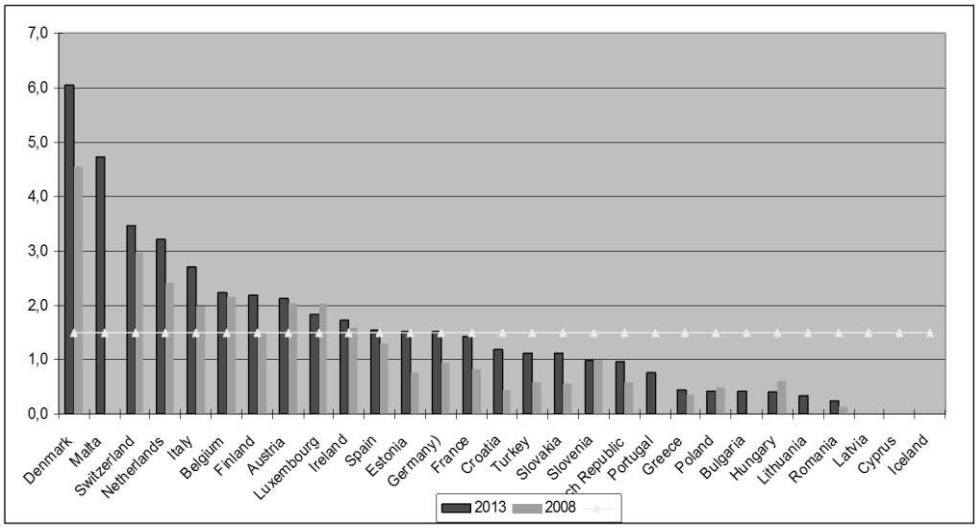
Source: own work based on data from EUROSTAT

Figure 5. Gamma cameras per 10, 000 population in selected countries in 2013 and 2008

The countries with the least number of gamma cameras per 10,000 population in Europe are Romania and Estonia (2.3). The third lowest numbers of GC per capita among 28 analyzed European countries was Bulgaria (2.8), and the four other countries, where the number of gamma cameras per 10,000 people was lower than 4 were: Latvia, Lithuania (3), Turkey (3.3) and Poland (3.5). These countries had much fewer GC per person than in most

other European countries. In 2013, the most GC per 10,000 population was in Belgium (23.5, but it regards only hospitals), Denmark (16.7), Luxembourg (14.7), Greece (14) and Austria (11.8).

Five years earlier, in 2008, the most gamma cameras per 10,000 inhabitants were also in Luxembourg (18.4) and Denmark (16.5); in third place was Cyprus and Iceland– 12.6. There were as many as six other countries with more than 10 gamma cameras per 10,000 individuals; whereas Romania again achieved the last place in Europe – 13.4. Almost half of the countries for which data are available in EUROSTAT database reported an decrease in this ratio between 2008 and 2013. The larges decrease was recorded in Iceland and the largest increase in Greece.

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Source: own work based on data from EUROSTAT

Figure 6.PET scanners per 10, 000 population in selected countries in 2013 and 2008

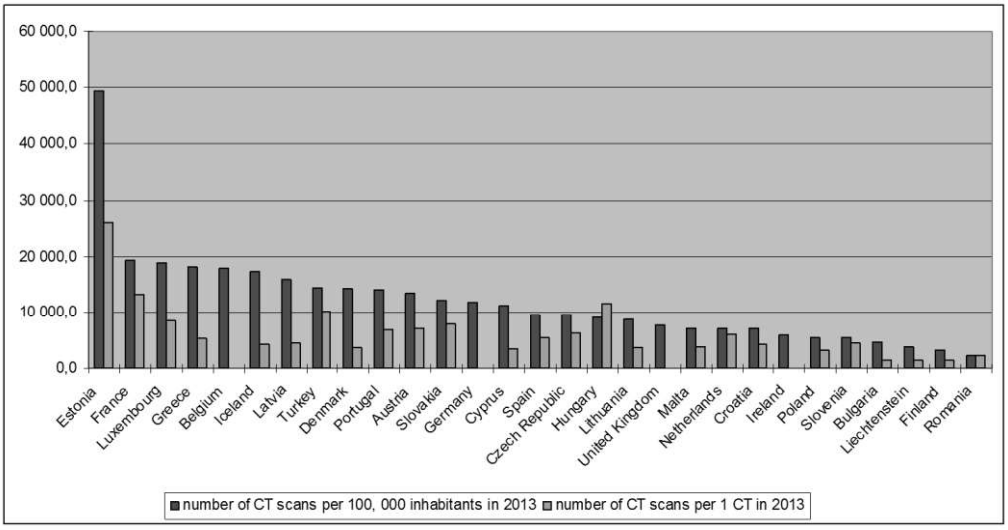
The imaging equipment that is least widely available are PET scanners. The country which had the most PET scanners per 10,100 inhabitants in 2013 was Denmark (6.1). Most of the countries for which data are available reported fewer ratios than 3. Between 2008 and 2013, the availability of PET scanners increased. The highest increase was observed in Malta as the number of such scanners increased from 0 to 4.7.

There is no general guideline regarding the ideal number of medical technology units per capita. However, not enough devices may result in geographic availability problems or waiting times. On the other hand too many devices may lead to an overuse of the costly diagnostic procedures, with little benefits for patients. Some European countries have developed clinical guidelines to promote more rational use of such diagnostic technologies. For instance the aim of such guidelines in the UK was to increase the number of appropriate examinations and reduce unnecessary examinations and health risk of patients. While there are no guidelines regarding the use of CT and MRI scanners in Greece, since late 2010, certain purchasing criteria has been established for the private sector. One of the main criteria is based on a minimum threshold of population density (30, 000 population per CT and 40, 000 per MRI). These regulations do not apply to the public sector. The number of these devices may also be the result of regulative policy measures instead of reflecting a

country's real technological advancement. New medical technologies are improving diagnosis and treatment, but they are also increasing health spending [M. Kroneman et al. 2004].

Medical imaging equipment is generally associated with a large amount of capital and operating expenses. Given this fact, it could be interesting to know to what extent these pieces of equipment operate intensively or not.

In order to assess the level of intensity in the use and operation of the medical equipment, two indicators of utilization were used: average number of exams per scanner per year and average number of exams per 100,000 inhabitants. Figures 7-9 present data on the use of a selection of three types of imaging equipment: CT scanners, MRI scanners and PET scanners.




Comment: Because of lack of the data for the Portugal, Austria, UK and Ireland refers only to hospitals, and for other countries also to providers of ambulatory health care

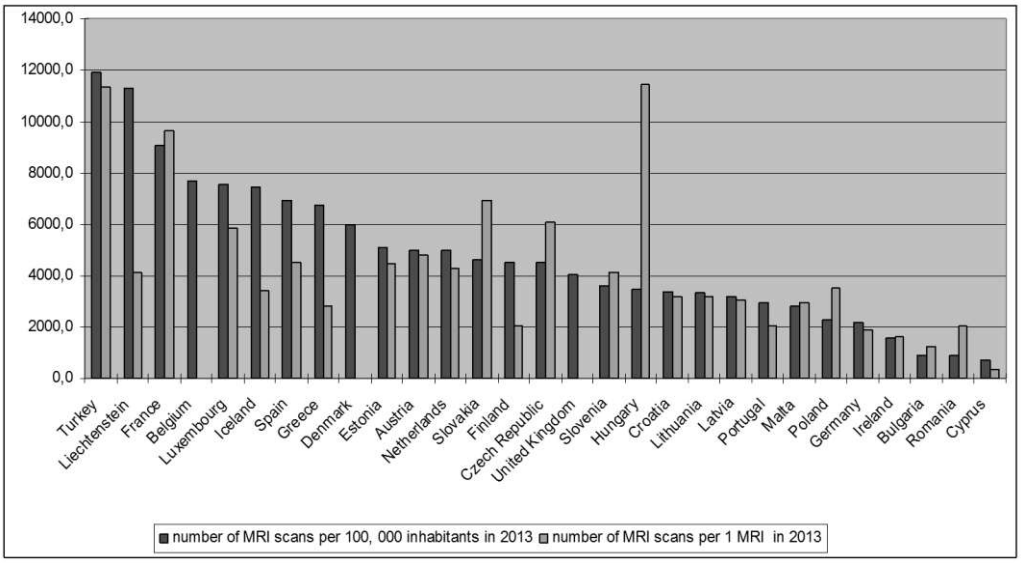
Source: own work based on data from EUROSTAT

Figure 7. Number of CT scans per 100, 000 population and per 1 CT in selected European countries in 2013

In 2013, the country with the least number of CT scans per 100,000 people in Europe is Romania (2.3 thousand). The second lowest numbers of CT scans per capita among the analysed countries were in Finland (3.2 thousand), and the third country where the number of CT scans per 100,000 people was lower than 4,000 was Liechtenstein (3.8 thousand). These countries reported much fewer CT scans per person than in most other European countries, and the ratio there was far lower than the average (11.9 thousand). In 2013, the most CT scans per 100,000 population were reported in Estonia (49.5 thousand), France (19.3 thousand), Luxembourg (18.9 thousand) and Greece (183) thousand). Eight years earlier, in 2008, the most CT scans per 100,000 inhabitants were reported in Greece – 32 thousand; in second place was Belgium – 18 thousand; and in third was Luxembourg – 17.8 thousand. There were as many as seven other countries with more than 10,000 CT scans per 100,000 individuals; whereas Romania again achieved the last place in the Europe – 968.

The number of C scans relative to population size increased across the European countries. Almost all countries for which data are available in Eurostat database reported an increase between 2008 and 2013 in the number of CT scans relative to the size of their

respective populations. The largest increase of scans per 100, 000 inhabitants was noted in Estonia (by around 35 thousand). The largest decrease in the number of scans was recorded by Greece (around 14 thousand scans per 100,000 people). An important indicator of the use of medical technology is the number of scans per number of equipment. In the comparison of the number of CT scans per one CT scanner, Estonia again dominated (26 thousand), in second place was France (13.2 thousand) and in third was Hungary (11.7 thousand). The countries with the least number of CT scanners per 100,000 people in Europe were again: Bulgaria (1.4 thousand), Liechtenstein (1.4 thousand), Finland (1.5 thousand) and Romania (2.3 thousand). In these countries, waiting for medical services seems to have become commonplace. Generally, the average number of CT scans per one scanner for analyzed countries in 2013 was small – 6.3 thousand per 1 CT scanner. The least intensive use of CT scanners was in Bulgaria, Liechtenstein, Finland and Romania - less than 2.5 thousand scans were made on average per CT scanner.




Comment: Because of lack of data, the data for the Portugal, Austria, Germany, UK and Ireland refers only to hospitals, and for other countries also to providers of ambulatory health care

Source: own work based on data from EUROSTAT

Figure 8. Number of MRI scans per 100, 000 population and per 1 MRI in selected European countries in 2013.

The data on use of technical resources regarding the number of MRI scans per 100,000 inhabitants has been provided by 29 countries. In 2013 the avarage ratio in analyzed countries was 4.8 thousand**.** It was higher than in 2008 (3.4 thousand). The number of MRI scans per 100,000 inhabitants ranged from less than 1,000 in Cyprus (689), Romania (889) and Bulgaria (914), to more than 10 thousand in Turkey (11.9 thousand) and Liechtenstein (11.3 thousand).

The highest number of MRI scans per 1 MRI scanners have been performed in: Hungary(11.5 thousand), Turkey (11.4 thousand), France (9.7 thousand) and the lowest one in: Cyprus (349), Bulgaria (1.3 thousand) and Ireland (1.6 thousand**).**

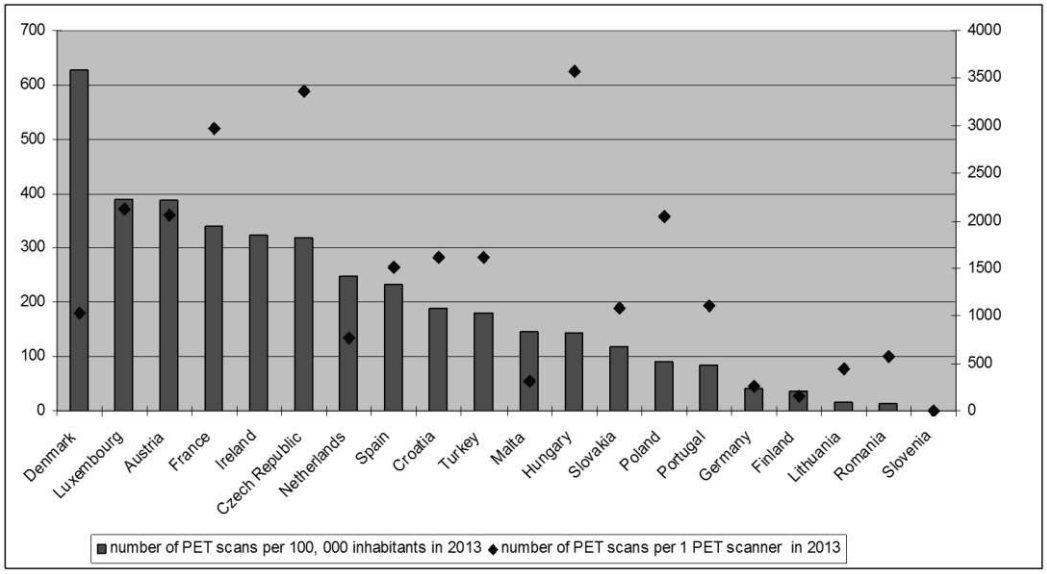
The average number of MRI scans per100,000 inhabitants has been increased

since 2008 in nearly all countries for which data are available. There was a particulary strong rise in Lichtenstein (by 7.1 thousand). A stroing growing trend can be also observed in the case of Turkey (7thousand), France (4.3 thousand) and Lithuania (2.5 thousand), Only in three countries, the number of MRI scans per 100,000 inhabitants fell during that period. This was the case in Greece, Cyprus, and Ireland.

The country with the highest number of PET scans per 100, 000 inhabitants in 2013 is Denmark (627), that is the country with the high number of other kinds of scanning services. It means that Denmark has been heavily investing in diagnostic equipment and increased the number of diagnostic services in the country in general. Three other countries with very high number of PET scans per 100, 000 people are: Luxembourg (390), Austria (387) and France (339). The countries with the lowest number of PET scans per 100, 000 inhabitants are mainly the less developed countries: Romania (14.5) and Lithuania (15).

The highest number of PET scans per 1 equipment in 2013 were reported in countries such as: Hungary (3.5 thousand), Czech Republic (3.4 thousand), and France (2.9 thousand); whereas the least intensive use was in: Finland (163), Germany (259), Malta (308) and in Slovenia where there were no scans made from PET scanners.

All countries reported an increase between 2008 and 2013 in their respective number of PET scans relative to the size of population.




Comment: Because of lack of data, the data for the Portugal, Austria, Germany, and France refers only to hospitals, and for other countries also to providers of ambulatory health care

Source: own work based on data from EUROSTAT.

Figure 9. Number of PET scans per 100, 000 population and per 1 PET scanner in selected European countries in 2013

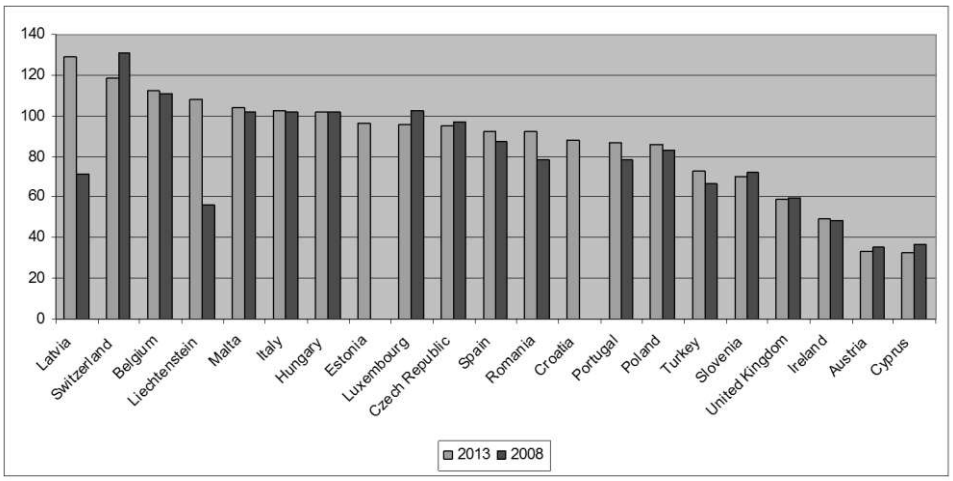
The highest increase in number of PET scans per 100, 000 inhabitants since 2008 is observed in Denmark (326 scans per unit). The other countries with the highest increase in the number of PET scans relative to population size are: France (184), and Czech Republic (152). The availability and utilization of hospital technical resources. The main technical resources in the hospitals are the operation theatres. They are very expensive and re-

source-intensive facilities within hospitals, which efficiency of utilization has a significant impact on patient throughput [E. Rowse, P.R. Harper, 2014].They are used to performs urgical procedures – the medical interventions, normally involving an incision with instruments and anesthesia and/or respiratory assistance. The single largest cost of a hospital in terms of capitalization and fixed and variable operating costs are connected with operating theatres, so it is desirable to optimize the efficiency of these resources [D. Hartmann, B. Sunjka 2013].

During the last five years, almost all European countries have increased the number of operation theatres available in hospitals. The basic information about the number of operation theatres in hospitals per ten thousand inhabitants in selected European countries is shown in Figure 10.

In 2013, in Europe, there were on average 86 operation theatres for every 10,000 inhabitants, ranging from 32,5 in Cyprus to 128,7 in Latvia. Very high number of operation theatres per ten thousand people were also found in Switzerland (118.18), Belgium (112.3) and Lihtenstain (108.2); whereas low numbers of operation theatres were in Austria (33.4) and Ireland (48,9).

Looking back over time we can see that most of the countries have seen an increase in the number of operation theatres. A percentage change indicator was calculated to illustrate the dynamics of the growth in the number of operation theatres per 10,000 individuals in various EU countries. A percentage change is a way of expressing a change in the analysed variables, representing the relative change between the old value and the new one.




Source: own work based on data from EUROSTAT

Figure 10 Number of operation theatres per 10, 000 population in selected European countries in 2013 and 2008

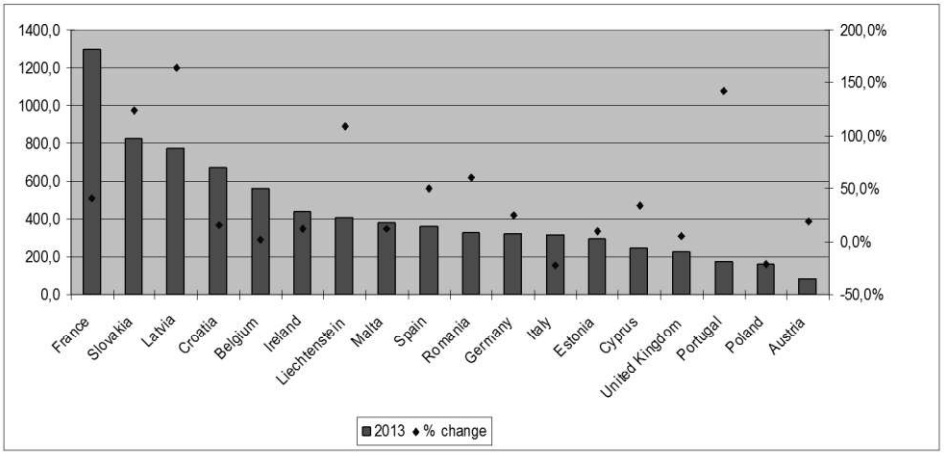
Since 2008, the number of operation theatres per 10,000 people has increased steadily in the most of European countries except for Cyprus (-11.2%), Switzerland (-9.1%), Luxembourg (-6.7%), Austria (-5.4%), Slovenia (-3.2%), Czech Republic (-1.8%) and United Kingdom (-0.6%).Figure 10 shows that the number of operation theatres has gradually increased in Liechtenstein since 2008, when there were 56.4 operation theatres per 10,000 people. Five years later, there were 91,8 per cent more operation theatres. A very high positive percentage change in the number of operation theatres per 10, 000 inhabitants is also theatres per 10, 000 inhabitants is also observed in Latvia (80 per cent).

There are quite high differences in the number of day care places per 10,000 population in various European countries (Figure 11). It should be noted that presented data regards

only day care paces offered by hospitals and doesn't include the services offered in other health care facilities, such as independent day-care centres or ambulatory premises.

The country with the highest number of day care places per 10,000 population in Europe is France (1295.4). A lot of day care places are also available in Slovakia (828.1) and in Latvia (775.6). For France the indicator of the number of day care places per10,000 population is higher than the mean for analysed countries (437.7) of almost 200percent.. The lowest number of day care places per capita among 18 analysed European countries has Austria (only 85.6). The other countries, where the number of such places is very low are: Poland (161.6) and Portugal (176.4).

The country with the highest number of day care places per 10,000 population in Europe is France (1295.4). A lot of day care places are also available in Slovakia (828.1) and in Latvia (775.6). For France the indicator of the number of day care places per10,000 population is higher than the mean for analysed countries (437.7) of almost 200 per cent. The lowest number of day care places per capita among 18 analysed European countries has Austria (only 85.6). The other countries, where the number of such places is very low are: Poland (161.6) and Portugal (176.4). The negative percentage change in the number of day care places per 10 000 inhabitants is observed only in Italy (- 23 percent) and in Poland (-21 percent). On the other hand the highest positive percentage change in the number of day care places per 10 000 inhabitants is observed in Latvia (165%), Portugal (142%), Slovakia (125%) and in Liechtenstein (109%).




Source: own work based on data from EUROSTAT

Figure 11 Number of day care places per 10, 000 population in selected countries in 2013 and average rate of change of number of day care places in the period 2008-2013

There are quite high differences in the number of psychiatric day care places in hospitals per10,000 population in various European countries. Psychiatric day care places regard the patients with mental health problems. They include places in psychiatric departments of general hospitals, and all beds in mental health hospitals.The country with the highest number of psychiatric day care places per 10,000 population in Europe is France (420.7). A lot of psychiatric day care places are also in Croatia (245.4), Germany (217.3) and in Belgium (205.29). The lowest number of psychiatric day care places per capita among analysed European countries has Poland (only 1.2). In many countries, the number of psychiatric day care places per 10,000 inhabitants is decreasing due to replacing the inpatient psychiatric care with the outpatients and day-care centres, and even in the system of social support.

In most of the countries there is not enough of the geriatric day care places. Geriatric care is a coordinated, interdisciplinary approach to providing distinct types of health care (medical, rehabilitative, and cognitive support services) to older adults directing their own care in partnership with geriatric care specialists and other providers with training in geriatrics [R. Wallace 2009].

In Europe, in the worst situations are the countries, where this rate is less than 0.5 geriatric day care places per 10, 000 inhabitants: Liechtenstein, Poland, Croatia and Rumania. Many countries in the EU is not prepared for aging population and they are not able to fully satisfy the health requirements of older people. The most geriatric day care places per 10, 000 inhabitants is in: Spain (50.7), Belgium (50.3) and in Germany (25.8).

Analyzing the structure of the day care places, we observe, that the most day care pla-ces in hospitals for psychiatric care were in such countries like: Germany (67%), Croatia (37%), Belgium (36%), and France (32%). In Spain, around half of the day care places in hospitals (45%) were oncological, in other words for the care of cancer patients, while in Liechtenstein, Slovakia and Italy day care in hospitals was mainly focused on surgery.

**Conclusion.** Progress in medical technologies continues to transform health care delivery and to improve life expectancy and quality of life, but it is also one of the main drivers of rising health expenditure [OECD, 2011]. The countries with the best availability of medical technology were identified using indicators of availability of various medical equipment per 10,000 inhabitants. Relative to population size and subject to data availability, the most imaging equipment among the European countries in 2013 were reported in Greece, Iceland, Italy Denmark and Switzerland. At the other end diagnostic and treatment units were the lowestin Romania and Hungary.

For example in Denmark there is the national scheme regarding preventive measures.[S. Kümpers et al. 2010]. Health protection and disease prevention is coordinated by the Ministry of Health, implemented by counties and municipalities. Also Greek health care delivery system is characterised by a strong emphasis on preventive care. The Greeks have access to numerous private diagnostic centres, which are a special feature of the Greek health care system. They are well-equipped, especially with capital-intensive technologies [P. P. Groenewegen, A. Jurgutis, 2013]

Nation wide, the availability of most of analyzed technologies has risen over time. The availability of equipment for diagnosis increased rapidly in most European countries over last five years, especially in the less developed countries. For example, in Bulgaria the number of computed tomography (CT) scanners per 10,000 inhabitants increased by 11.8 thousand, the number of MRI ratio increased by 4.1 thousand and the number of mimeographs per 10,000 inhabitants increased by 6.6 thousand. In Latvia the number of computed tomography (CT) scanners per 10,000 inhabitants increased by 11.8 thousand, the number of MRI ratio increased by 6.3 thousand and the number of mimeographs per 10,000 inhabitants increased by 5.7 thousand. Over the last five years, the most notable increases were for CT scanners. Between 2008 and 2013 the number of CT units per 10,000 people increased in Liechtenstein by 27 thousand, and in Denmark by 16.3 thousand. CT scans were the most commonly performed diagnostic procedures private diagnostic centres, which are a special feature of the Greek health care system. They are well- equipped, especially with capital-intensive technologies [P. P. Groenewegen, A. Jurgutis, 2013]. Nation wide, the availability of most of analyzed technologies has risen over time. The availability of equipment for diagnosis increased rapidly in most European countries over last five years, especially in the less developed countries. For example, in Bulgaria the number of computed tomography (CT) scanners per 10,000 inhabitants increased by11.8 thousand, the number of MRI ratio increased by 4.1 thousand and the number of mimeographs per 10,000 inhabitants increased by 6.6 thousand. In Latvia the number of computed tomography (CT) scanners per 10,000 inhabitants increased by 11.8 thousand, the number

of MRI ratio increased by 6.3 thousand and the number of mimeographs per 10,000 inhabitants increased by 5.7 thousand. Over the last five years, the most notable increases were for CT scanners. Between 2008 and 2013 the number of CT units per 10,000people increased in Liechtenstein by 27 thousand, and in Denmark by 16.3 thousand. CT scans were the most commonly performed diagnostic procedures The countries with the best utilization of medical resources are: France and Luxembourg. They have the one of the best indicators of number of various diagnostic services per 100,000 inhabitants and per number of diagnostic units. The countries with the worst utilization of medical resources are: Romania, Bulgaria and Finland.

In 2008–2013, the number of exams per capita increased considerably in most of the European countries, especially in France, Denmark and Turkey. In these cases, this was due to an increase in the denominator (the number of scanners).

The analyzed data do not allow recommendations about the appropriate level of medical resources because indicators give insufficient information about the effectiveness of resource utilization. However, data comparison, clearly indicate that there are different ways of achieving a desired outcome and that international experience can be a guide to more effective health care provision.

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