TAXONOMIC ANALYSIS OF THE POLISH PUBLIC HEALTH IN COMPARISON WITH SELECTED EUROPEAN COUNTRIES

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ABSTRACT

As an international organization the European Union pursues a range of purposes including improvement of public health, prevention of human illness and diseases as well as elimination of the sources of danger to physical and mental health. To enable effective health policies supporting actions of the member states, the data and materials which are fundamental to public health assessments are collected at the Community level. They underpin a variety of analyses necessary to evaluate changes in medical systems and determine the degree of similarity between the EU member states.

This article analyses public health in Poland in relation to selected European countries. The study is based on the medical, economic and social indicators available from the EUROSTAT database. The taxonomic methods used in the study allowed ranking the sampled countries and identifying those with the highest level of public health. A more detailed assessment was based on the general presentation of health care systems in each country. In addition to Poland, the other post-socialist countries in the sample are Bulgaria, Estonia, Lithuania, Romania, Slovenia, Hungary and the Czech Republic. Importantly, the study covers the years 2004-2009, after most of the countries joined the European Union. The reason why other former Eastern bloc countries were omitted from the study was the unavailability of appropriate data in the EUROSTAT database. The paper discusses a group of developed European countries too. However, because the complicated historical past of the post-socialist countries and the socio-economic difficulties that result from it make their analysis more interesting from a comparative point of view, they are the primary group explored in this article.

This article is divided into theoretical and empirical section. It begins with a short introduction. Part two presents the concept of health and public health. The third part describes key factors differentiating health systems. It briefly presents the main healthcare models, that is: the Bismarck's, Beveridge's, Siemaszko's and the residual model. The fourth section refers to a grouping method based on Hellwig's taxonomic measure of development. Part five with its scope includes a

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comparative analysis of public health status of selected European countries. The sixth part presents major determinants of cluster formation. The paper ends with a conclusion that summarizes the obtained results.

Key words: Public health, taxonomic measure of development, comparative analysis.

1. Introduction

Today's Europe is populated by several hundred ethnic groups and nations totalling over 730 million people[1]. In the year 1000 the population living on the old continent was less than 40 million, but within the next 900 years the number rose to 408 million, to be more than 725 million in the year 2000[2]. The recent generations were growing up in the period of "demographic explosion", when the number of population was expanding at a very fast rate. The growth was certain to continue and the only questions it brought about were: Will it be fast, very fast or perhaps lightning fast? Will our planet be able to provide space and food for so many inhabitants? These concerns turned out to be ungrounded. Today's forecasts show that by the year 2020 the European population will decline to 715 million and then to ca. 650 million in 2050[3]. The old continent, particularly the European Union, is faced by a low or negative natural increase and the aging of its population. These circumstances increase the interest in demographic transformations and, particularly, in their socio-economic impacts on social security systems whose main purpose is to protect people against so-called social risk. One element of this protection is healthcare[4] (others are social welfare, old age and disability pensions, protection against unemployment, etc.).

2. The notion of health and public health

„Health" may be interpreted from different angles and its meaning greatly varies depending on the accumulated knowledge, scientific achievements, attitudes as well as cultural norms prevailing in societies.The five-thousand year old Chinese medicine defines health as a balance between two types of energy: ying and yang[5]. If the balance is disturbed, then diseases appear. This approach

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[1] United Nations Statistics Division (2011). The above number depends on how the geographic area of Europe is defined. In 2011 the EU population stood at over 500 million people. In the same year the number of the non-EU population in Europe was estimated at more than 230 million.

[2] United Nations Population Division and http://www.fordham.edu/halsall/source/pop-in-eur.asp (26 March 2012).

[3] United Nations, Eurostat, Berlin Institute for Population and Development.

[4] According to the ILO definition of 1955.

[5] Two opposing energies that joined to create the universe. One may not function without the other. In discussions on health ying represents systemic fluids and human tissue, while yang is energy, warmth, activity and productivity.

seems to explain why preventive measures are so popular in the Far East. Prevention comes before treatment (Lisowski, 2000). The Chinese tend to treat a human being rather than a disease, so analysis of the patient's environment is necessary. Considering the longevity of the Chinese, their young appearance and the low rate of civilisation diseases in China, this approach seems to work very well and, although not fully comprehensible to the Europeans, it has had a direct bearing on the practice of western medicine.

Hippocrates, one of the predecessors of modern European medicine known as "the father of medicine", was of the same opinion. He too associated health, that is feeling well, and illness, i.e. feeling bad, with a balance between the patient's environment and lifestyle (Korczak, 1977).

Medicine has made huge progress since Hippocrates times, mainly due to the scientific revolution in the 19th c. The meaning of most notions has been changed, or rather has been extended. One of the basic and most popular definitions of health that are in use today was formulated by the world Health Organization (WHO) in 1948: „Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity"(WHO, 1948). In the 21st c. the meaning of health is not limited to mental and physical well-being, i.e. to the correct functioning of the human organism. People live more intensive lives today, so social, economic and cultural, sometimes also spiritual determinants occurring in their environments must be taken into account. All of them affect health which is a multifaceted phenomenon.

The health of the general public is called public health. These two terms are only different in that health is an attribute of individuals, while public health is used with respect to populations. Summing up, public health equals population health. It is a multidisciplinary field of science incorporating the elements of many other disciplines, such as epidemiology, sociology, psychology, pedagogy, economics, and law. The notion of public health has lost its purely medical dimensions.

The origin of the term dates back to the 18th c.[1]. Traditionally, public health has been interpreted only in terms of hygiene and contagious diseases. Today it is understood as the science and the art of preventing diseases, extending life expectancy and promoting health through collective efforts of the society (Acheson, 1998). According to the WHO, public health in its broad sense, i.e. as „new public health", consists of:

issues concerning population health,

population health status,

general health services,

healthcare administration (WHO, 1973).

The WHO Health Promotion Glossary of 1998 explains that the reason for drawing a line between „public health" and „new public health" was the need to

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[1] Johann Peter Frank (1745-1821) – a German physician who provided the fundamentals of modern hygiene, epidemiology, forensic medicine, state-managed healthcare. Frank is credited to develop the concept and the notion of „public health".

accentuate completely different approaches to describing and analysing health determinants and methods for solving population health problems that are used within these two areas (WHO, 1998). New public health is characterised by full knowledge of how lifestyles and living conditions determine human health status. It also requires that the needs relative to the use of resources are identified and that appropriate investments in solutions, services and institutions that create, maintain and protect health are made. These characteristics of public health have caused that the WHO views it as a socio-political concept serving the improvement of health and quality of life of whole populations through various kinds of interventions.

The definitional scope of both health and public health is very extensive. There are many definitions, concepts and interpretations that have been developed for these two terms, which are not only of crucial importance, but also, more importantly, complementary. Population health is an aggregate of the health of individuals.

The state must therefore understand the fundamental importance of both individuals and the entire population being able to enjoy the same degree of care. Otherwise statehood becomes a meaningless notion, because states may not exist without individual citizens.

3. The models of healthcare systems

Health represents the highest social priority and value. But it is also a product delivered by the sector of medical care. It is not possible for individual patients to influence the functioning of their organisms, which are exposed to various external stimuli.

According to Marc Lalonde's health field concept[1], the status of human health is determined by four factors: biology (genetic determinants), the environment, the lifestyle and healthcare. In his model, the greatest influence on human health is attributed to lifestyle (over 50%), while healthcare contributing only 10% is the least important. It is not likely, though, that a human with "good genes" and living healthy life will be safe from diseases and accidents. Therefore, nations need institutions and establishments providing medical assistance and consultations and taking care of the sick. This role is performed by healthcare understood as „a separate whole made of many diverse elements interconnected by various ties (representing different interactions) that pursues health-related objectives" (Włodarczyk, Poździoch, 2001). Accordingly, healthcare includes all kinds of activities whose main purpose is to promote, restore and sustain health (WHO 1984).

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[1] Marc Lalonde – former Minister of National Health and Welfare in Canada. In 1974 he published the report "A New Perspective on the Health of Canadians" where he presented the "health fields" concept; http://pl.wikipedia.org/wiki/Marc_Lalonde (26 Februry 2012).

The healthcare sector is one of the main branches in the economy of every country. The health systems of particular countries pursue the same goals, but differ from each other in the circumstances that have led to their establishment. Countries can be roughly divided into developed, developing and the Third World countries in the poorer and less industrialised areas. Different countries are characterised by different standards of living and levels of development, as well as having distinctive historical past and unique socio-economic problems that arise from it. This means that all analyses, programmes, policies and solutions addressed to the different parts of the world may not miss the huge differences between nations, their rates of economic growth and health status.

The key factor differentiating health systems is the way they are funded and organized. The main healthcare models are the following:
- the Bismarck's model (based on insurance),
- the Beveridge's model (based on taxes, national budget, and national health service),
- the Siemaszko's model (in centrally-planned systems),
- the residual model (a market-based solution).

Table 1. Models of healthcare systems

Bismarck's model	Beveridge's model	Siemaszko's model (a bygone model – socialist health service)
Funded from predominantly mandatory premiums paid by employees and employers	Funded from general taxation or other state revenues	Funded from general taxation or other state revenues
All premium payers are entitled to use services, mainly employees and their family members	All (almost) citizens in the country are entitled to benefits	All (almost) citizens in the country are entitled to benefits
Funds are distributed through sickness funds	Funds are distributed through central (national) or decentralised (national or subnational) institutions of public administration	Funds are distributed through central (national) and regional institution of public administration
The „basket of services" is created by excluding some types of services (e.g. all or some dental services, plastic surgery, and physiotherapy)	The "basket of services" is very general and broad, practically depending on public investments	The "basket of services" is very general and broad, practically determined by public investments
Mainly private service providers acting for profit	Mainly public service providers	Only public service providers

Table 1. Models of healthcare systems (cont.)

Bismarck's model	Beveridge's model	Siemaszko's model (a bygone model – socialist health service)
Contracts between payers and service providers	The central level allocates funds to the intermediate level (including local governments) and to service providers using centrally determined rules	The central level allocates funds to the intermediate level (of governments administration) and to service providers according to centrally determined rules
Rates, frequently the same across the country, are determined in contracts via an administrative/negotiatory mechanism	Fund allocation rules are defined at the central or regional level in relation to the available infrastructure and population characteristics	Fund allocation rules are defined at the central level in relation to the infrastructure
Financing per service	Cavitation financing and master budgets (mainly for hospitals)	Financing rules based on conversion factors related to infrastructure
Co-payment for most services	Minimal co-payment	Co-payment is not used (expanding „grey zone")
Service providers of choice.	Regulated access to successive levels of healthcare	Assignment to regional/ local structures of service providers, so-called catchment areas

Source: Siwińska V., Brożyniak J., Iłżecka J., Jarosz M. J., Orzeł Z., Modele systemów opieki zdrowotnej w Polsce i wybranych państwach europejskich, Praca poglądowa, Zdrowie Publiczne 2008.

The fourth healthcare model which has been omitted from the table is the residual model using market solutions, where health is treated as a commodity. Healthcare services are considered goods to be exchanged via commercial transactions. They can be sold and purchased as any other product. The key factor is the purchasing power of the buyer. The model lays stress on personal responsibility. It is for an individual to make all decisions and to accept all health risk. The public sector protects poor people, the elderly, and mothers and children in difficult life situation. The government exercises very limited control of the expenses and the allocation of resources. All inputs invested in the functioning of healthcare (labour, capital) are expected to bring returns to those who made them, according to the free market principles (Włodarczyk, 1996).

Each of the healthcare models is different and all of them have their advantages and disadvantages. A single model that could solve the problem of diseases and medical dilemmas in the country does not exist. Which health care system is adopted is simply a consequence of the strategy that the state follows. The choice is determined by its health policy, available resources, the

opportunities for their redistribution, as well as the level of funding and its sources. In practice, countries mostly use the modified versions of the above models, which borrow solutions from each other.

Europe has more than a dozen of healthcare solutions that have evolved, to a different degree and in different proportions, from the main models. Most countries have built their systems on the oldest of the classical solutions, which was created by Chancellor of the German Reich, Otto von Bismarck. These are Germany, Austria, France, the Netherlands and Switzerland, as well as Japan and Israel outside Europe. The national healthcare system devised by Lord Beveridge after World War II has been adopted with many modifications by the Nordic countries, Spain, Portugal, Ireland, the United Kingdom, Italy, etc. Canada is one of the non-European users of this system. The least common model which represents a mixture of the two models is used in Belgium and Greece. The USA uses a system built on strictly market principles.

The system that Poland had in the inter-war period was structured on the Bismarck model. The historical events after World War II caused that the Eastern bloc countries, including Poland, adopted the Siemaszko's model, which strongly resembles that developed by Lord Beveridge. The system was never fully implemented in our country, but most of its solutions remained in force until 1998, when the health care system started to be remodelled towards the Bismarck's concept.

Table 2. Countries grouped by their healthcare systems

A Bismarckian-type model	A Beveridge-type model	A mixed model with elements of the Bismarck's and Beveridge's models	A system originally based on the Siemaszko's model, evolving into the Bismarck model
Germany, Austria, France, Netherlands, Switzerland, Luxemburg	Denmark, Finland, Norway, Iceland, Sweden, UK, Ireland, Spain, Portugal, Italy	Belgium, Greece	Albania, Bosnia-Herzegovina, Bulgaria, Croatia, Estonia, Hungary, Lithuania, Latvia, Poland, Romania, Czech Republic, Slovakia, Slovenia, Macedonia
outside Europe: Japan, Israel	outside Europe: Canada		And the former USSR countries, e.g. Armenia, Belarus, Georgia, Kazakhstan, Russia, Ukraine

Source: Developed by the author.

After the World War II, many countries started to restructure their healthcare systems, aiming to create modern, better organized and "welfare" systems. The specific solutions they chose were determined by their policy and potential. The different rates of social development and wartime losses have caused that any unification of the systems has not been possible to date. This seems to explain why particular countries use diverse methods, instruments and solutions, although the objectives and goals are similar.

The former Eastern-Bloc countries were faced with the gravest problems, because they had to switch from central-command economies to free market systems only several tens of years after the end of the greatest armed conflict in world history. Economic rigidities, shortage of goods, unrealistic economic plans, excessive employment ("hidden" unemployment), the lack of effective motivation systems are only few of the problems that haunted countries subordinated to communist ideology. They had a direct bearing on the situation of the thoroughly centralised healthcare systems, contributing to the low health status of population, lengthening queues of patients seeking consultations from specialist physicians and to technological backwardness. It was not until the collapse of the regime that the anachronistic nature of the system in the former socialist bloc became fully exposed. Hence, the systemic transformation complete, reforms of the health care systems had to be undertaken, whose main principles were borrowed from models used elsewhere.

4. A grouping method based on hellwig's taxonomic measure of development

Taxonomy is used for classifying and ordering objects characterised by many parameters and properties and its roots go back to biological sciences. It originally served the purpose of grouping live organisms based on their anatomic and physiological characteristics. A breakthrough in its use was a study by the Polish scientist Jan Czekanowski[1], who developed his own taxonomic method in 1913. His method basically consists in ordering and sorting objects by grouping them into possibly homogenous classes[2]. Czekanowski's research gave impulse for using taxonomy in other fields of science, such as medicine, sociology, and economics.

The classification methods allow creating homogenous groups of objects and reducing a large amount of data to several major categories, thus enabling more general conclusions to be reached. Another advantage is that they help cut the

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[1] Jan Czekanowski (1882-1965) – Professor at the Lvov University (1913-1941) and the Catholic University of Lublin, head of the Chair of Anthropology and Ethnography, of the Chair of Anthropology at the Adam Mickiewicz University in Poznan, full member of the Polish Academy of Sciences, a member of the Polish Statistical Association and the Polish Biometric Society.

[2] http://www.stat.gov.pl/cps/rde/xbcr/gus/POZ_Zasluzeni_statystycy_dla_nauki.pdf (5 March 2012).

time and costs of research, because the number of necessary analyses can be limited to the most important issues.

One of the major taxonomic methods is the Hellwig's synthetic measure of development. It is a linear ordering method, where the points in a multidimensional space are projected onto a straight line1. The analysed objects are ordered with respect to the accepted model development which is a synthetic measure integrating the characteristics and information from a series of variables into one aggregate indicator. These properties of the Hellwig's method make it possible for the analysed objects to be ordered by the level of phenomena that cannot be quantified with a single measure, e.g. the quality of life, population health status or technological progress. That multifaceted phenomena can be described with a single numerical value and makes the identification of their level much easier, as well as the facilitation of creation and analysis of comparative rankings.

The first step in constructing the Hellwig's taxonomic measure of development is to determine the range of diagnostic variables to be used in the study (x1, x2,…, xk) and to create a matrix of information on particular objects. The matrix is written as:

$$X = \begin{bmatrix} X_1 \\ X_2 \\ ... \\ X_m \end{bmatrix} = \begin{bmatrix} x_{11} & x_{12} & ... & x_{1k} \\ x_{21} & x_{22} & ... & x_{2k} \\ ... & ... & ... & ... \\ x_{m1} & x_{m2} & ... & x_{mk} \end{bmatrix} \tag{1}$$

where: x_{ij} – the value of the j-th diagnostic variable for the i-th object; i = (1,2…,m),

j = (1,2…,k); m – the number of objects, k – the number of diagnostic variables.

In the next step, the matrix is standardised with the following formula:

$$Z_{ij} = \frac{x_{ij} - \overline{x}_j}{S_{xj}} , \quad i = (1,2…,m), \ j = (1,2…,k) \tag{2}$$

where: x_{ij} – the empirical value of the j-th diagnostic variable for the i-th object,

$\overline{x}_j$ – the arithmetic mean in the distribution of the diagnostic variable x_j,

S_{xj} – the standard deviation in the distribution of the diagnostic variable x_j.

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[1] In the method of non-linear ordering points in a multidimensional space are projected onto a plane.

The synthetic model variable, i.e. the model development, is obtained from the standardised variables:

$$P_{0j} = [z_{01}, z_{02}, \ldots, z_{0k}], \tag{3}$$

where: $z_{0j} = \max(z_{ij})$ for stimulant variables,

$z_{0j} = \min(z_{ij})$ for destimulant variables.

A stimulant and a destimulant are diagnostic variables whose higher values indicate better or worse situation of the object, respectively.

In the next step, the Euclidean distance between each object and the model development P_{0j} is determined:

$$d_{i0} = \sqrt{\sum_{j=1}^{k}(z_{ij} - z_{0j})^2} \; , \quad i = (1,2\ldots,m), \; j = (1,2\ldots,k), \tag{4}$$

where: z_{ij} – the normalized values of the *j*-th variable for the *i*-th object,

z_{0j} – the normalized value of the model development for the *j*-th variable.

In order to normalize coefficient d_{i0}, a relative taxonomic measure of development is computed for particular objects:

$$z_i = 1 - \frac{d_{i0}}{d_0} \tag{5}$$

where:

$$d_0 = \overline{d}_0 + 2S_0 \tag{6}$$

$$\overline{d}_0 = \frac{1}{m}\sum_{i=1}^{m} d_{i0} \tag{7}$$

$$S_0 = \sqrt{\frac{1}{m}\sum_{i=1}^{m}(d_{i0} - \overline{d}_0)^2} \tag{8}$$

where: $\overline{d}_0$ – the arithmetic mean of the distances to the model development,

S_0 – the standard deviation of the distances to the model development.

The measure takes values within the range [0:1]. The higher its value, the closer the examined object to the model and the better its situation. A result close to zero points to a very disadvantageous situation of the object. Based on the values of the taxonomic measure of development, the objects can be ordered by the level of the analysed phenomenon.

With the arithmetic mean and the standard deviation calculated for the relative measure of development four categories (clusters) were distinguished, which were then assessed with a four point-scale ranging from very good to unsatisfactory. It

must be noted at this point, though, that the scale levels are relative, because they only rank the sampled countries and use the available variables.

I group – very good $\qquad \bar{z} + S_z < z_i$ $\qquad$ (9)

II group – good $\qquad \bar{z} < z_i \leq \bar{z} + S_z$ $\qquad$ (10)

III group – satisfactory $\qquad \bar{z} - S_z < z_i \leq \bar{z}$ $\qquad$ (11)

IV group – unsatisfactory $\qquad z_i \leq \bar{z} - S_z$ $\qquad$ (12)

where: $\quad \bar{z}$ – the arithmetic mean of the relative measure of development,

$\quad S_z$ – the standard deviation of the relative measure of development.

5. A comparative analysis of public health status

Public health status is a multifaceted phenomenon whose complexity prevents analysis based on its one property only. A multivariate approach including, for instance, taxonomic methods is necessary.

Because of the limited availability of the data, this analysis has covered eight post-socialist countries: Bulgaria, the Czech Republic, Hungary, Estonia, Romania, Lithuania, Slovenia and Poland. To find out how their achievements compare with the situation in the non-Eastern Bloc countries, the analysis has been extended to three Nordic countries – Finland, Norway and Sweden – and six Western-European countries represented by Germany, France, the Netherlands, Austria, Portugal and Switzerland. The research period spanned the years 2004-2009, which is important to note because all the selected post-socialist countries are new members of the European Union that joined it just in 2004, except for Bulgaria and Romania that became EU members 3 years later. Among the sample countries, Germany, France and the Netherlands are the oldest members of the Community. Their accession to the EU, then called the European Economic Community[1], took place in 1957. Norway and Switzerland are non-EU countries, but one belongs to the European Economic Area[2] and the Schengen Area[1] (Norway) and the other to the Schengen Area (Switzerland).

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[1] The European Economic Community (EEC) was an international organization formed as a result of integration processes initiated after WWII. It started to function on 1 January 1958 based on the Treaty of Rome whose signatories were Belgium, France, the Netherlands, Luxemburg, FRG (the United Germany since 1990) and Italy on 25 March 1957. The EEC turned into the European Union. On 1 December 2009 the EU acquired legal personality and replaced the EEC (called the European Community since 1993), taking over all its powers.

[2] The European Economic Area (EEA) is a free-trade area and a single market for the EU and EFTA (European Free Trade Association) members (except for Switzerland). The EEA is based on four pillars, i.e. the free **movement of people, capital, goods and services**.
http://pl.wikipedia.org/wiki/Europejski_Obszar_Gospodarczy (6 March 2012).

The analysis started with the selection of appropriate diagnostic variables for describing public health status in the selected countries. The status was identified by means of medical and economic, as well as social indicators. All data were complete, available and relevant to the description of the analysed phenomenon.

The initial set of variables contained:
- ✓ the number of practicing primary care physicians per 100,000 population (a stimulant),
- ✓ the number of students graduating from medical studies (physicians) per 100,000 population (a stimulant),
- ✓ the number of hospital beds per 100,000 population (a stimulant),
- ✓ the number of patients discharged from hospitals per 100,000 population (a destimulant),
- ✓ average hospitalization time [days] (a destimulant),
- ✓ standardized mortality rate (a destimulant),
- ✓ female life expectancy (a stimulant),
- ✓ male life expectancy (a stimulant),
- ✓ healthcare spending [a percentage of GDP] (a stimulant),
- ✓ healthcare spending – long-term care [a percentage of GDP] (a stimulant).

It is worth noting that well-selected diagnostic variables should be weakly correlated (to avoid duplication of information), and should be characterized by a high degree of variability. For this purpose, on the basis of carried out calculations, too strongly correlated variables were removed from the set of initial variables, as well as those variables for which the coefficient of variation was not greater than 10%. These variables were in fact reconsidered as quasi-permanent, what means that they do not provide relevant information about the analyzed issue. Variables that were eliminated are female and male life expectancy, both stimulants. Therefore, the final analysis included eight variables, five stimulants and three destimulants.

The clarity of the paper requires to remark that variables were divided into stimulants and destimulants and their values were used to obtain the synthetic model variable according to the below mentioned rule:

$$z_{0j} = \max(z_{ij}) \text{ for stimulant variables, } z_{0j} = \min(z_{ij}) \text{ for destimulant}$$

variables,

where: z_{ij} – the normalized values of the *j*-th variable for the *i*-th object.

The above chosen diagnostic variables were used for making calculations and ordering countries by public health status based on the Hellwig's taxonomic measure of development (Table 3).

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[1] The Schengen Agreement was signed on 14 June 1985 in Luxembourg. It has removed all personal border control between the member states, while providing for closer cooperation between their security services.

Table 3. The selected European countries ordered by public health status according to the taxonomic measure of development (z_i), years 2004-2006

No.	2004		2005		2006	
	Country	z_i	Country	z_i	Country	z_i
1	Austria	0,405	Austria	0,398	Austria	0,395
2	France	0,388	France	0,392	Netherlands	0,381
3	Netherlands	0,365	Netherlands	0,366	France	0,380
4	Norway	0,335	Norway	0,319	Norway	0,311
5	Germany	0,308	Germany	0,308	Germany	0,298
6	Switzerland	0,307	Switzerland	0,286	Switzerland	0,276
7	Portugal	0,239	Portugal	0,251	Portugal	0,261
8	Sweden	0,224	Slovenia	0,231	Sweden	0,244
9	Slovenia	0,214	Sweden	0,226	Slovenia	0,183
10	Finland	0,156	Romania	0,196	Finland	0,171
11	Romania	0,155	Finland	0,156	Romania	0,169
12	Czech Republic	0,143	Czech Republic	0,147	Czech Republic	0,157
13	Hungary	0,129	Hungary	0,131	Hungary	0,137
14	Poland	0,108	Estonia	0,115	Estonia	0,128
15	Estonia	0,101	Poland	0,092	Poland	0,081
16	Bulgaria	0,097	Bulgaria	0,087	Bulgaria	0,058
17	Lithuania	0,054	Lithuania	0,029	Lithuania	0,055

Source: developed by the author based on the Eurostat data.

Table 4. The selected European countries ordered by public health status according to the taxonomic measure of development (z_i), years 2007-2009

No.	2007		2008		2009	
	Country	z_i	Country	z_i	Country	z_i
1	France	0,389	Austria	0,362	Austria	0,386
2	Austria	0,368	France	0,354	Netherlands	0,368
3	Netherlands	0,367	Netherlands	0,347	France	0,363
4	Norway	0,308	Norway	0,312	Norway	0,303
5	Switzerland	0,279	Portugal	0,266	Germany	0,280
6	Portugal	0,278	Switzerland	0,258	Portugal	0,270
7	Germany	0,273	Germany	0,251	Sweden	0,212
8	Sweden	0,227	Sweden	0,206	Switzerland	0,177
9	Romania	0,199	Slovenia	0,187	Czech Republic	0,176
10	Slovenia	0,167	Finland	0,186	Finland	0,174
11	Czech Republic	0,149	Romania	0,154	Slovenia	0,174
12	Finland	0,143	Czech Republic	0,136	Lithuania	0,158
13	Hungary	0,138	Estonia	0,101	Estonia	0,137
14	Poland	0,105	Hungary	0,095	Romania	0,118
15	Estonia	0,094	Poland	0,088	Hungary	0,112
16	Bulgaria	0,059	Lithuania	0,080	Poland	0,075
17	Lithuania	0,058	Bulgaria	0,046	Bulgaria	0,023

Source: developed by the author based on the Eurostat data.

The table reveals significant movements in the rankings of particular countries. In all analysed years but 2007 Austria ranked first. Between 2004 and 2009 France and Netherlands continued to rank alternatively second or third position except for 2007 when France took the first place. This means that the health status of the Austrian, Dutch and French populations was the closest to the model development. Between 2004 and 2009 Norway maintained its 4th place in the ranking. Except for Austria and Norway seven more countries maintained their places in the raking during the first three years of the analysis: Germany (5), Switzerland (6), Portugal (7), the Czech Republic (12), Hungary (13), Bulgaria (16) and Lithuania (17). In the years 2007-2009 position of these countries was not so stable. Other countries ranked differently in particular years.

In the analysed period, the following countries moved up in the ranking:
- the Czech Republic – 11th and 12th in the years 2004-2008, became 9th in 2009,
- Lithuania – last and penultimate places between 2004 and 2008, but 12th in 2009,
- Portugal – ranked 7th in the years 2004-2006 and 6th in 2007 and 2009 became 5th in 2008.

On the other hand, the countries below moved down the scale:
- Switzerland – ranked 5th and 6th in the years 2004-2008, but 8th in 2009,
- Poland – ranked 14th and 15th between 2004 and 2008, but 16th in 2009,
- Hungary – ranked 13th and 14th in the years 2004-2008, but in 2009 it was 15th,
- Romania – ranked 9th, 10th, and 11th in the years 2004-2008, but 14th in 2009,
- Germany – ranked 5th in the years 2004-2006 and in 2009, but 7th in the years 2007-2008,
- Slovenia – ranked 8th, 9th, and 10th in the years 2004-2008, but 11th in 2009,
- Finland – ranked 10th and 11th in the years 2004-2006 and in 2008-2009, but 12th in 2007.

The lowest level of public health in the analysed years was found in Bulgaria, which ranked last twice (2008-2009), being also penultimate four times (2004-2007). Lithuania also ranked last (2004-2007), but in 2008 it moved up by a notch to the penultimate place and then to the 12th place in 2009, which shows that public health status in this country was changing for the better.

The analysis leaves no doubts that the last five places in the ranking were typical of the former Eastern bloc countries. All changes in their rankings were limited to this group. The post-socialist country that ranked higher was Slovenia, which outdistanced Finland in the period 2004-2008. However, in 2009 the two countries swapped their places and Finland ranked higher again. Two more former Eastern bloc countries that ranked higher than Finland are Romania in 2005 and 2007 and also the Czech Republic in 2007 and 2009. None of other former Eastern bloc countries ranks higher than the Nordic or Western European countries in the sample. It is worth noting that across the analysed years public health status in the last countries in the ranking was quite far from the model development, clearly pointing to a large distance dividing the post-socialist countries and the ranking leaders.

Among the Eastern bloc countries being relatively new EU member states public health status was best in Slovenia, which ranked more or less in the middle of the sample. Interestingly, it was outdistanced only twice by the other post-socialist countries, by Romania in 2007 and by the Czech Republic in 2009. Positive trend was found in the Czech Republic, whose more or less regular place throughout the years 2004-2008 and its promotion to the 9th place in 2009 testifies to quite stable health policy pursued in the country. An interesting solution that has been implemented in the Czech Republic is that patients are required to cover some costs of medical services which generates additional revenues for healthcare; their 2008 volume was estimated at around €200 million.

The fact that Austria, France and the Netherlands invariably ranked in the first three places between 2004 and 2009 is not surprising. These countries are the oldest members and the founders of the European Union. All other countries in this analysis that usually ranked among the leaders joined the Community much later, except for Germany.

The basic descriptive statistics of the synthetic variables were used to put the countries into groups (to cluster them) according to their public health status in the years 2004-2009.

Table 5. The groups of the sampled European countries by their public health status, years 2004-2009

Group	2004	2005	2006	2007	2008	2009
I	Austria France Netherlands Norway	Austria France Netherlands	Austria Netherlands France	France Austria Netherlands	Austria France Netherlands Norway	Austria Netherlands France
II	Germany Switzerland Portugal Sweden	Norway Germany Switzerland Portugal Slovenia Sweden	Norway Germany Switzerland Portugal Sweden	Norway Switzerland Portugal Germany Sweden	Portugal Switzerland Germany Sweden	Norway Germany Portugal Sweden
III	Slovenia Finland Romania Czech Republic Hungary	Romania Finland Czech Republic Hungary Estonia	Slovenia Finland Romania Czech Republic Hungary Estonia	Romania Slovenia Czech Republic Finland Hungary Poland	Slovenia Finland Romania Czech Republic Estonia	Switzerland Czech Republic Finland Slovenia Lithuania Estonia Romania Hungary
IV	Poland Estonia Bulgaria Lithuania	Poland Bulgaria Lithuania	Poland Bulgaria Lithuania	Estonia Bulgaria Lithuania	Hungary Poland Lithuania Bulgaria	Poland Bulgaria

Source: Developed by the author.

The groups are represented graphically in Chart 1.

Chart 1. Groups distinguished in the set of 17 European countries, years
2004-2009
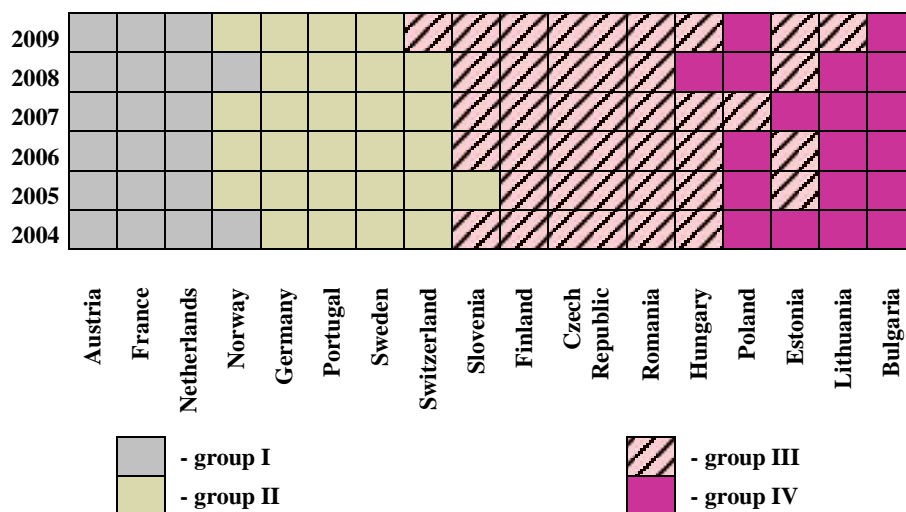
Source: Developed by the author.

Austria, France and the Netherlands are unquestionable leaders in the ranking. In the analysed period they always belonged to the top group. Norway joined it in 2004 and 2008. Group II consists of countries where public health status is good. Its steady members were Germany, Portugal and Sweden. Norway belonged to this group almost throughout the sample period, excluding years 2004 and 2008, when it was promoted to Group I. Besides these five countries, Switzerland was also a five-time member of Group II, in the years 2004-2008. The only post-socialist country that ranked that high is Slovenia which joined Group II in 2005. Group III was the largest in the year 2009, when its members were Switzerland, the Czech Republic, Finland, Slovenia, Lithuania, Estonia, Romania and Hungary. Group III is made of countries where public health status was found to be satisfactory. Finland, the Czech Republic and Romania were permanent members of this group; Lithuania joined it in 2009 and Estonia in the years 2005-2006 and 2008-2009. Group III was the smallest in the years 2004-2005 and 2008. In 2008 its only members were Slovenia, Finland, Romania, the Czech Republic and Estonia, while other countries felt to Group IV (Hungary, Poland). In 2008 Poland felt from Group III to Group IV, joining Hungary, Lithuania and Bulgaria. On the other hand, in 2009 countries in Group III were joined by Hungary and Lithuania; the latter managed to get out from the lowest group only once in the entire period. In the other years Lithuania was in the worst performing Group IV encompassing countries with unsatisfactory level of public health. Bulgaria did not manage to leave this group even once. It is worth stating that Poland entered into Group IV as many as five times, joining Lithuania and

Bulgaria. Our country moved up to Group III only once, in 2007. Other members of Group IV were Estonia in 2004 and 2007, and Hungary in 2008. A quite surprising finding was to see Finland in Group III in all the analyzed period. It may have been expected that the principles of health and welfare would rank it higher in relation to other countries, closer to Norway.

Across the analysed years Austria, France and the Netherlands (Group I), Germany, Portugal and Sweden (Group II), Finland, the Czech Republic and Romania (Group III) and Bulgaria (Group IV) were the steady members of their groups. Bulgaria turned out to be the worst in the ranking, never leaving the group of countries characterised by the unsatisfactory status of public health (IV). Lithuania made the greatest progress, moving from the worst group in the years 2004-2008 to Group III in 2009. Quite interesting is the situation of Estonia, which felt to the worst group only twice. It is likely that Estonia owes this positive change to the increasingly close cultural relations with Finland and Sweden. Estonia presents herself as a Nordic country more and more often, which may have a positive influence on both her economy and the healthcare system. Slovenia was the most successful among the post-socialist countries – it outdistanced Sweden once, Finland five times and managed to retain is approximately middle place in the ranking throughout the analysed period. In other former Eastern bloc countries health status was not satisfactory. Regrettably, its level was very remote from the model development.

6. Major determinants of cluster formation

This section presents the evolution of the four main characteristics contributing to the emergence of a clear-cut gap between the Western European countries and the post-socialist countries. The characteristics (variables) are presented for particular groups in the years 2004-2009.

Chart 2. The average number of practicing primary care physicians per 100,000 population in each group, years 2004-2009
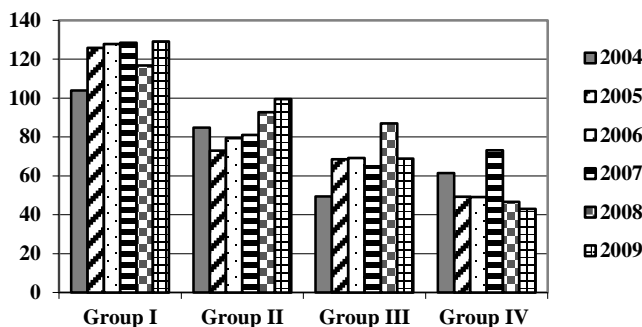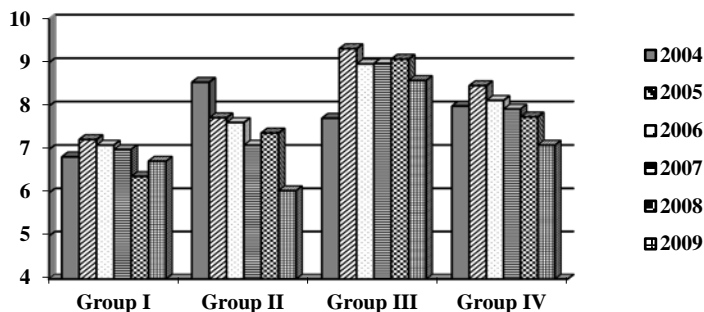

Source: Developed by the author.

Chart 3. The average number of hospital beds per 100,000 population in each group, years 2004-2009
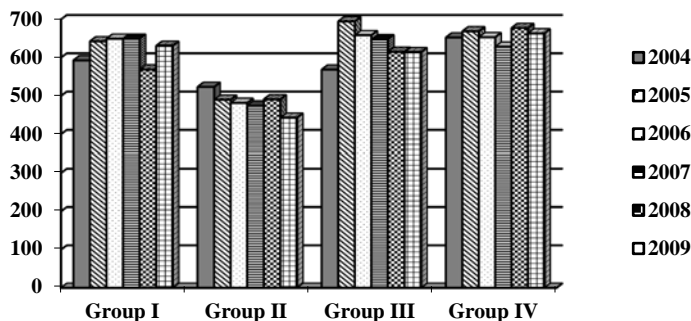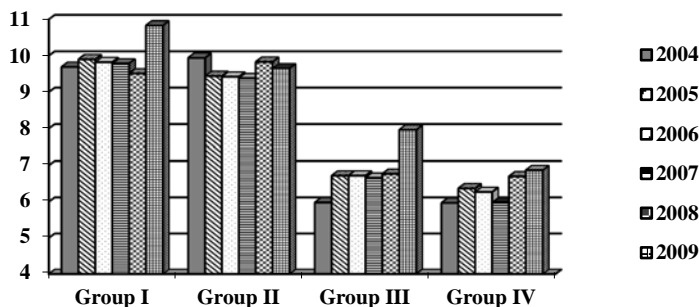

Source: Developed by the author.

Chart 4. The average patient hospitalization time in each group, years 2004-2009

Source: Developed by the author.

Chart 5. The average healthcare spending [% of GDP] in each group, years 2004-2009

Source: Developed by the author.

Charts 2-5 show that particular diagnostic variables contribute to the formation of clearly dissimilar clusters. In all analysed years, Groups I and II have higher average numbers of practicing primary care physicians (particularly cluster I), higher shares of healthcare expenditures (as % of GDP) and shorter average hospitalization time per patient compared with the other two groups. The latter finding also denotes a lower average number of hospital beds, because more efficient patient turnover allows better use of this resource.

7. Conclusion

The taxonomic analysis of public health presented in this article covered 17 European countries. Three of them were Nordic countries, six were Western European countries, and the other countries in the sample were former Eastern bloc countries, which makes their socio-economic situations and the resultant development opportunities very similar. The research has shown that in the 2004-2009 ranking the leaders were countries that based their healthcare systems on the Bismarck's model. Among the first four countries only one (Norway) has a healthcare system drawing on the Beveridge's concept. The post-socialist countries where historical circumstances determined the long-term use of the Siemaszko's model ranked the lowest. Most members of the former Eastern bloc started to reform their health systems only around 15 years ago, using the solutions adopted by the "old" EU members. The process can be expected to continue, bringing forth a sort of functional unification across the Community systems. A case in point is Slovenia where some functional characteristics of its healthcare system are not different from those in the leading countries. It is worrying, though, that Poland was in the worst group almost for the entire analyzed period. The country managed to change its position and move upper to Group III only once, in 2007. That year Poland outdistanced three post-socialist countries – Estonia, Lithuania and Bulgaria.

Poland's low ranking in the years 2004-2009 reveals the difficult situation of the Polish healthcare system. There are several issues that contribute to its poor performance. The first of them seems to be huge problems of public finances that necessitate austerity measures affecting also the healthcare sector. The second issue is inadequate health policy and poor adjustment between healthcare and changing demographic circumstances, particularly regarding fast aging of population. Aging increases the need for medical services, thus deepening the imbalance between their supply and demand (also spatially; for instance, the demand tends to concentrate in large urban centres). Moreover, Poland has not implemented solutions that have been proven effective in countries with healthcare systems based on the Bismarck's model, such as co-payment. Adjusted to the prevalent financial circumstances, co-payments are not burdensome for individuals, but their total volume may make a large difference in the amount of funding available to health service.

As shown by the analysis, between 2004 and 2009 mainly only two post-socialist countries in the sample (Lithuania and Bulgaria) had worse public health status than Poland. That shows that Poland is still very distant from the model development as well as from the Nordic and Western European countries. Besides, the status has not recently improved. For the sake of illustration, the Ranking Patient Empowerment Index developed in 2009 ranked the Polish healthcare system among the worst systems in Europe. Out of an attainable maximum of 1000 points Poland scored only 528, ranking 25th among 31 analysed countries. Although the scope of the Index and the variables it used somewhat differ from this research, the PEI report is an important point of reference that provides guidelines for future studies in this field.

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