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In search of healthcare system ideal types — Changeable classifications and dimensions

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Abstract

This article aims to classify the healthcare systems of 43 developed economies into different healthcare system types, and to examine whether the dimensions of health system characteristics produce coherent health system classification when the dimensions are observed separately. We group health systems into different types based on their institutional structures and performance using healthcare financing, healthcare provision and health outcomes as dimensions of the health system characteristics. Unlike previous classifications, we classify each dimension separately using hierarchical cluster analysis. In particular dimensions, our results resemble those found in previous classifications. However, no coherent clustering of healthcare systems was found across the three dimensions. The results show that healthcare system dimensions differ from each other and each of them form their unique system types. Separating the dimensions helps detecting connections between the healthcare system types and phenomena being studied. It is relevant to note the differences of health system dimensions while discussing healthcare system classifications.

Keywords: healthcare system typology, healthcare system classification, healthcare system types, hierarchical cluster analysis, healthcare system dimensions

Introduction

Welfare states strive to provide well-being for their citizens, which is why healthcare systems play a major role in welfare states around the world. The way in which healthcare is organized is highly relevant in everyday life. From a comparative perspective, healthcare systems, like other institutions of welfare states, are understood as ways to reduce various social risks and inequalities (Korpi & Palme, 1998). As a societal mechanism, healthcare systems produce health services by converting generalized resources into specialized products (Field, 1973).

In this article, we examine whether the dimensions of health system characteristics produce similar classifications of health systems when the dimensions are observed separately. This study classifies the healthcare systems in 43 developed economies from Africa, Asia, Europe, Middle East, South+West Pa-

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cific, North and South America. Previous healthcare system classifications have categorized healthcare systems based on, for example, their actors, financing, performance, service provision, and regulation of access to care (Field, 1973; Schieber, 1987; Reibling et al., 2019; Wendt, 2009). The classifications of various dimensions have varied depending on their focus and intended use.

However, overall, preceding classifications combine several dimensions, with a view to capture the large variety of characteristics within a healthcare system. In this article, we take a more comprehensive approach by classifying health systems of OECD (Organisation for Economic Co-operation and Development) countries according to three different dimensions, (1) health system financing, (2) performance, (3) and provision and organization. Instead of combining all three dimensions into the same model, we analyse them separately. In this way, we attempt to construct a more nuanced narrative about the variation between the components of healthcare systems.

Previous classifications (Reibling et al., 2019; Wendt, 2014) have expanded to cover countries outside of North America and Europe but however, excluded African and South American countries. In this study, we examine the OECD countries and its six non-member economies (Brazil, China, Costa Rica, Indonesia, Russia and South Africa) , and hence this is the first study to include as many as 43 countries in a health system classification, expanding the range of Asian and Eastern European countries, while also including two more continents—Africa and South America—in the analysis. The research question is to find out if there are coherent clusters across the three dimensions of the health system characteristics (financing, provision and outcomes).

The following section begins by outlining the complexity involved in classifying healthcare systems and highlights several previous healthcare system classifications that have gained wider attention in the literature. In the third section, we present financing, provision, and health outcomes characteristics of the OECD healthcare systems, which function as dimensions of our classification. We then describe the methodology used for comparing health systems and identifying the different system types. After presenting the results, the concluding discussion summarizes this papers' contribution in classifying healthcare systems.

The complexity of healthcare system classifications

Classifications play a central role in comparative health system research, which is reflected in many existing classifications, ranging from descriptive to analytical in their approach (Burau et al., 2015). To compare healthcare systems cross-nationally, the information on national health systems can be condensed into ideal types that are simpler versions of the actual systems. The concept of an ideal type, formulated by Weber (1978), refers to distinguishing the characteristics of a group we are interested in, and is a central feature of classification (Freeman & Frisina, 2010). When it comes to classifying a broad range of healthcare systems, the complexity of those systems requires simplifying (Burau & Blank, 2006). Healthcare systems can be classified into distinct system types according to their combination of different characteristics (Freeman & Frisina, 2010), that can be categorised into dimensions, such as financing, provision, health outcomes. However, some information about the specific features of the healthcare systems disappears when defining comparable dimensions and indicators for the classifications.

Classifications of healthcare system types vary according to the combination of institutional structures they are composed of (Freeman & Frisina, 2010), and also lately, the extent of achieving performance goals (Reibling et al., 2019). By studying various combinations of such structures and performance measures, we arrive at different classification solutions. Toth (2016) summarizes the limitations of the classifications, stating that healthcare systems differing from one another end up in the same group, while similar ones end up in different groups. While Freeman and Frisina (2010) question the salience of classification problems, they still emphasize the need to classify, regardless of the uncertainty and shortcomings attached to it. Classifications help to explain and generalize health policies cross-nationally and organize information about the features pertaining to different health systems. In the field of comparative health policy, classifi-

cations support conceptualizing the institutional structures and context in which health policy is embedded (Burau & Blank, 2006). Healthcare systems characteristics are intertwined with the social, economic, and political processes of societies (Freeman & Frisina, 2010).

In previous studies, classifications of healthcare systems include measures of health system actors (e.g., Böhm et al., 2013; Wendt et al., 2009); regulation of access to care (e.g., Wendt, 2009; Wendt et al., 2009; Reibling, 2010); financing (e.g., Schieber, 1987; Reibling et al., 2019; Wendt, 2014; Moran, 2000); service provision (e.g Field, 1973; Wendt, 2014; Böhn et al., 2013; Moran, 2000; Bambra, 2005); ownership of the service provision (e.g., Field, 1973; Schieber, 1987); technology (Moran, 2000; Reibling, 2010); and performance (Reibling et al., 2019). The wide range of measures and the focal points of the classifications have resulted in a situation whereby in the literature, none of the classifications outpace the others. If one were to highlight just one landmark study, it would be the widely cited OECD classification in which three healthcare system models are outlined: the National Health Service, the Social Health Insurance and the Private Health Insurance (Schieber, 1987). However, the classification has been criticized for focusing only on the financing of the health systems (Burau & Blank, 2006).

Comparative research is characterized by an effort to balance theory and available data, which are also the foundations of classifying health systems. In addition, classifications are a trade-off between simplification and exactness. Even though scholars agree healthcare systems are hybrids and do not wholly represent any of the ideal models (Böhm et al., 2013; Wendt et al. 2009), there is always a risk of oversimplifying the actual systems. Health system classifications lack precise measures specifying the range of similarity the systems must share to group them in the same category (Freeman & Frisina, 2010). However, the aim of healthcare classifications is not to reveal the definitive truth or an ultimate model but rather to develop our understanding of health systems and their characteristics, which in turn function as a basis for comparing aspects of health systems (Burau et al., 2015; Freeman & Frisina, 2010), such as quality, equity, cost effectiveness, performance, and effectiveness.

Generalizing the features of greatly differing health systems is the strength of classifications. Even though generalizations are founded on theoretically appropriate dimensions, they also simplify the features of healthcare systems which, in reality, are highly complex. As Burau et al. (2015) describe it, the use of classifications for comparing healthcare systems hovers between generality and specificity. This challenge has become more prominent as geographical comparisons have expanded and differences between healthcare systems increased (Burau, 2012). While we agree that limitations exist, we do, however, consider that even though healthcare systems compose of integrated and separated subsystems, those subsystems form an all-encompassing entity that is meaningful to analyse and categorize. We hypothesize that when subsystems of health systems are analysed separately, they produce different classifications of healthcare systems than when being studied in unison. This can be expected as the health system classifications produce distinct results depending on the characteristics and countries included in the analyses (Burau et al., 2015; Freeman & Frisina, 2010). We propose to form healthcare system types for different subsystems, dimensions, of health systems instead of integrating all the dimensions into one classification. Thus, changes in healthcare system types may be easier to detect and explain and moreover, applying the types in other research areas might become more fruitful in the future.

Materials and methods

Data

In this paper, we classify the healthcare systems of 43 countries into healthcare system types by means of a cluster analysis. The countries were chosen because they represent distinctive healthcare systems from various geographical areas and are OECD's member states or their selected non-member economies. This paper expands the range of countries in Asia and Eastern Europe, and brings two more continents, Africa,

and South America, into the analysis. Of the non-member economies, only India was excluded as we were unable to find the information on the country's gatekeeping and primary healthcare delivery from the World Health Organization's (WHO) or OECD's publications. Moreover, due to the data availability and comparability, we restricted our analyses to countries whose healthcare-related data is collected by the WHO and OECD. Our data represents health systems with versatile financing, provision and performance characteristics which enables us to cluster these characteristics in a way that meaningfully highlights the similarities and differences of these health systems and indicates the advantages of diversifying the country selection in healthcare system classifications.

Table 1. Means, standard deviations, minimums and maximums of all variables.

Variable	Mean	Median	Std. Dev.	Min	Max
Financing					
Current health expenditure per capita in US$, PPP (CHE)	3,747.8	3,242.4	2,203.7	375.2	10,623.9
Domestic general government health expenditure, % of CHE	68.3	72.4	12.8	31.2	85.3
Private household out-of-pocket expenditure, % of CHE	21.2	18.4	9.4	7.7	42.1
Provision					
Medical doctors, per 10,000 population	38.8	37.6	15.7	4.3	79.3
Hospital beds, per 10,000 population	43.2	35.3	26.2	9.8	129.8
UHC index for service coverage	79.2	79.4	6.2	57.0	89.0
Primary healthcare delivery	1.7	1	0.8	1	3
Gatekeeping	1.8	2	0.8	1	3
Health outcomes					
Measles-containing-vaccine first-dose immunization coverage, % of 1-year-olds	94.2	95.0	4.8	70.0	99.0
Maternal mortality ratio, per 100,000 live births	18.4	7.0	33.4	2.0	177.0
Age-standardized cancer death rates (15+), per 100,000 population, both sexes	340.6	329.9	59.4	193.9	501.8
Difference in life expectancy between males and females in years, at birth	5.1	5.0	1.8	2.7	9.8
Life expectancy at birth in years, both sexes	79.9.	81.4	3.7	65.3	84.3

Source: WHO (2020); Country HiTs (European Observatory on Health Systems and Policies, n.d.), (The Asia Pacific Observatory on Health Systems and Policies, n.d.); Lorenzoni et al. (2019); Paris et al. 2010; WHO (2017), notes: Gatekeeping: strong = 1 (compulsory), moderate = 2 (financially encouraged/partial gatekeeping), low = 3 (no obligation and no incentive); Primary health care: mainly private = 1 (private clinics/group/solo practices), mixed = 2, mainly public = 3 (public centres or solo practices)

Measures of healthcare financing, provision and outcomes are collected from the Global Health Observatory's (GHO) data repository (WHO, 2020). The repository includes health-related statistics on the WHO member states. In addition, we used the Health Systems in Transition (HiT) reviews as complementary

data alongside the GHO data, as the gatekeeping and primary care orientation indicators are derived from the HiTs. HiTs cover countries of the WHO European, Western Pacific and South-East Asia regions as well as some additional OECD countries (European Observatory on Health Systems and Policies, n.d.; Asia Pacific Observatory on Health Systems and Policies, n.d.). Yet, HiT reviews exclude Brazil, Chile, Colombia, Costa Rica, and South Africa. However, the equivalent information on healthcare system organization was derived from OECD working paper on Latin American and Caribbean health systems characteristics (Lorenzoni et al., 2019), and WHO's case study of South African primary healthcare system (WHO, 2017). Even though HiTs were unavailable for five countries, it was possible to collect the same information for them as for the other countries in the data. In this way, we achieved to include a wider range of countries in the analysis to observe the classification patterns of healthcare systems.

All the data presented above is freely available for non-commercial use from the respective websites. We analysed the data using version 3.6.1 of the R statistical program (R Core Team, 2019). All the data is expressed as numerical data and Table 1 shows descriptive statistics of all the variables in the data. Appendix 1 presents the study data, data sources, more detailed information on data collection years and methods.

Selection of the health systems characteristics

Financing

Financing represents an institutional arrangement of health systems (Paris et al., 2010), and highlights the characteristics of expenditure and financing of the health systems. The measure of current health expenditure (CHE) presents the actual amount of resources invested in healthcare and the financial capacity of the healthcare systems and societies to provide care (Wendt, 2009). CHE is measured in $US per head of population by using purchasing power parity. In addition to the above-mentioned indicators, private and employer-provided health insurances play an important role in health financing in many countries (Colombo & Tapay, 2004). However, we had to exclude an indicator of private health expenditure, including households' and corporations' expenditure, from the analysis because of high correlation with the government health expenditure indicator. Due to data availability issues, we were unable to include separate indicators for private health insurance and enterprise financing expenditures in the analysis.

To measure public expenditure on healthcare, we use general government health expenditure as a percentage of CHE to capture the role of the government in financing and organizing healthcare. The role of the government indicates the way in which it controls healthcare payments or to what extent organizing healthcare is seen as a public responsibility (Wendt, 2009). The indicator of household's out-of-pocket payments as a percentage of CHE represents the healthcare costs of private households as well as the role of the markets in healthcare. In addition, the indicator reflects inequalities in the service coverage as high levels of out-of-pocket payments can hamper access to care for citizens with lower income and weaker health (Wendt, 2014; OECD, 2019). Even though customer health service co-payments can be either fixed or income-based (Thomson et al., 2019), the current data on private out-of-pocket payments does not separate different types of customer payments which is the reason why we focus on all health spending of private households.

Provision and organization of health services

Provision and organization of health services inform us about the physical access to care and organization of health service supply (Paris et al., 2010). As well as financing, provision of healthcare supply is a significant institutional structure of healthcare systems, and we capture it by looking at the coverage of essential health services, the public-private mix in healthcare delivery, access regulation, the level of health employment and facilities.

The number of hospital beds and doctors reflect the volume of health employment and facilities allocated to organizing health services. The number of hospital beds is measured as the total number of hospital beds per 10,000 population and the number of medical doctors as the density of practising doctors per 10,000 population.

Primary care is an integral part of health service delivery organization which functions as a first contact, continuing and accessible care for a broad range of health needs practicing within communities (WHO, 1978; Starfield et al., 2005). Primary care has a beneficial impact for example on population health, health equalities and access to health services (WHO, 2008; Kringos et al., 2010; Macinko et al., 2003), which contribute to larger health policy goals (WHO, 2000). We use WHO's index of coverage of essential health services (UHC) to indicate the capacity and the access to essential care, mainly primary care services, in different health systems. The UHC index includes 16 different indicators of service access and coverage of infectious and non-communicable diseases, reproductive, maternal, newborn and child health (WHO, 2020). The UHC index is a summary measure of those 16 different indicators, and its values vary on a scale of 0 to 100; the larger values mean wider coverage of essential health services.

Previous studies have examined ownership of health services provision by looking at the public-private mix of health service supply which captures the roles of different health system actors (Böhm et al., 2013; Wendt et al., 2009). We operationalize public-private mix with the measure of primary healthcare delivery which describes the roles of the public and private sectors in the provision of primary care services. The measure describes the way in which primary care providers are contracted in the health system. Primary care is organized mainly in the public sector when primary care is provided in public health centres or solo practices; both in the public and private sectors (public and private health centres and solo practices); or mainly in the private sector, when primary care services are organized in private clinics or group or solo practices. The measure of primary healthcare delivery acquires value 1 when delivery is mainly private; value 2 when delivery is both private and public; and value 3 when the delivery is mainly public.

Gatekeeping systems reflect the coordination of care in primary care settings when primary care providers manage the use of other levels of healthcare (Macinko et al., 2003). General practitioners' (GP) role as gatekeeper is intended to ensure that different levels of care are used appropriately (Paris et al., 2010). In previous studies (Reibling et al., 2019; Wendt, 2014; Wendt, 2009; Reibling, 2010), as in this study, gatekeeping measures the way in which patients access to specialist care is regulated. The gatekeeping measure used in this study is based on the work of Reibling (2010), Paris et al. (2010) and Wendt (2014). Patients may have the freedom to choose a specialist and direct access to a specialist of their choice; they may need a referral from a GP to access specialist medical care; or they may skip referrals and pay for their access to a specialist. The indicator acquires value 1 when the level of gatekeeping in health systems is strong (compulsory); value 2 when the level is moderate (financially encouraged/partial gatekeeping); and value 3 when the level is low (no obligation and no incentive for gatekeeping).

Health outcomes

In line with Reibling et al. (2019), we approach the classification of health systems by integrating health system performance measures in the analysis. Healthcare outcome measures illustrate the quality and performance of the health systems. However, unavoidably, they also capture broader social contexts such as level of hygiene, health behaviours, and economic situation. To measure healthcare system outcomes, we chose indicators that represent individual and population level health outcomes. Although a rich supply of health outcome measures exists (Evans & Murray, 2003a), due to the completeness of the data for the selected time and countries, we decided to use measures of health conditions covering communicable diseases, population, maternal and child health on which the quality of healthcare systems may impact. Also, we discern the multidimensionality of healthcare system performance and quality of care (Smith et al., 2009; Murray & Evans, 2003a). However, this study focuses on the health outcomes perspective, as health outcomes measure the way in which health systems respond to health needs (WHO,

2000).

The indicators of measles-vaccine coverage and maternal mortality resemble the quality of maternal and child healthcare (Kringos et al., 2010). Both indicators are also United Nations' Millennium Development Goals (United Nation, 2015). Measles-vaccine coverage is measured as measles-containing-vaccine first-dose immunization coverage among 1-year-olds (%); and maternal mortality ratio per 100,000 live births.

The indicator of age-standardized cancer deaths reflects the quality of specialized care as cancer is treated at the higher levels of health systems. Cancer is the second leading cause of mortality in OECD countries: it accounts for 25% of all deaths (OECD, 2019). Thus, cancer deaths an important measure to examine healthcare system outcomes. The indicator is measured as age-standardized cancer death rates per 100,000 population.

We measure population health outcomes with two indicators: life expectancy and inequality in life expectancy. These indicators measure health system performance in terms of population health and equity in health distribution across different population groups (Papanicolas & Cylus, 2015). Following on the intrinsic health system goals, the measures take into account the average level of population health between countries and the distribution of population health inequalities within countries (see Murray & Evans, 2003b). The measure of life expectancy at birth captures the average level of population health. The measure of inequalities in life expectancy represents the way in which population health is distributed between the citizens of a same country and is measured as the difference in life expectancy at birth in years between males and females. The difference is calculated by subtracting the life expectancy of males from the life expectancy of females. While the health inequalities could also be assessed by examining the socioeconomic inequalities, in this paper, we focus on the health distribution between genders.

While the two measures of life expectancy are unable to distinguish to what extent health systems contribute to life expectancy instead of other societal domains (labour market, educational system, or family structures) or behaviour, environmental and biological factors, they are suitable for cross-country comparisons which include a variety of diverse countries, since life expectancy is an established indicator of population health (Smith et al., 2015). Also, we wanted to include a measure of population health which considers different aspects of health systems and societies that determine health inequalities which are, for example, affected by differences in health behaviour or educational background (Mackenbach et al., 2003; Mackenbach et al., 2008). In this way, we can understand health systems broadly as "all the activities whose primary purpose is to promote, restore or maintain health" (WHO, 2000), and measure their performance by looking at the differences in life expectancy.

Cluster analysis

Cluster analysis has become a standard way of classifying countries into groups (Gough, 2001; Jensen, 2008). We use hierarchical clustering as our research method as we were not looking for preconceived models. Hierarchical clustering is a useful method because it takes into account complex information from multiple variables and determines the alikeness of the cases (Everitt et al., 2011). Moreover, cluster analysis highlights clearly the possible outliers in the data.

For our purposes, the advantage of hierarchical cluster analysis is that it shows the hierarchical order of the segments that are grouped together. This is particularly important when the aim is to group health systems into different types based on their varying characteristics. Though latent class analysis and k-means clustering, for example, may have other advantages, the option to reveal the hierarchical order of the data is unavailable in these segmentation methods. However, to strengthen the robustness of our results, we compare the hierarchical clustering results with the results obtained from other types of cluster analysis.

Cluster analysis has received criticism over its vagueness in choosing the number of clusters, clustering techniques and proximity measures as different methods produce distinct results on the same data (Fonseca, 2013). The problem is that a particular clustering method cannot be recommended since the

mathematically favourable solutions do not produce results that are empirically meaningful to interpret making the empirical studies seldom conclusive (Everitt et al., 2011: 83, 110). Even though cluster analysis, has its limitations as any other method,its advantage is the ability to maintain and uncover abundant qualitative natures of the phenomenon being studied, with results being based on sound quantitative methods (Mandara, 2003).

Cluster analysis requires the researcher to make a set of decisions which are explained well by Reibling et al. (2019) and Mandara (2003). When uncovering natural typologies, the selected variables should reflect the phenomenon being studied (Mandara, 2003), due to which the variables of this study were explained in detail in the previous section and in Appendix 1. We started off by standardizing the data by dividing all variable means by their standard deviations. and categorized the healthcare systems using an agglomerative hierarchical clustering method which distributes data in several series; it starts with the first division in which all the units form their own cluster, while the final division includes all units in the same cluster (Everitt et al., 2011, 67–68, 73). This clustering method makes our results comparable with previous classifications. We used Gower's coefficient, expressed as dissimilarity, and Euclidian distance measure to determine the similarity between different healthcare systems—i.e., distances between each observation of the dataset. While the former measures the distance between two observations as the root sum-of-squares of differences, the latter measures the distance between two observations as the sum of all the variable-specific distances divided by the number of variables for which data exists for both of those two observations (Everitt et al., 2011, 50, 54). We applied the Euclidian distance measure to cluster the financing and outcome types since they included only continuous variables. Data that contained both continuous and categorical variables were clustered with Gower's coefficient (see Everitt et al., 2011), which we used when clustering the healthcare system provision and combined types.

We present the results of the hierarchical clustering in a tree-based figure known as dendrogram, which illustrates the fusions of the clusters completed at each stage of the analysis. It helped us to interpret and choose a suitable number of groups that describes the data the best. To validate the number of cluster solutions, we used elbow method, which helps us to choose a small value of clusters that still has a low sum of squared errors, and Calinski-Harabasz index, which gives us the ratio of the sum of between-clusters variance and of inter-cluster variance. The index indicates that the more suitable the cluster number, the bigger the value it acquires. The complete linkage method was used to interpret the results because it produced the most meaningful cluster solutions. The variable correlations, the sensitivity analyses with different clustering methods (the results of clustering with average linkage, k-means and k-medoids methods) and the results of elbow method and Calinski-Harabasz index are presented in Appendix 2. We clustered the data with R package cluster (Maechler et al., 2019).

Results

The studied health systems are classified into financing, provision, outcome and combined types. Figures 1a–1d represent the results of four cluster analyses and their colours are based on the cluster solutions of the healthcare system combined types. By doing this, we detect the way in which countries change places in the different types. Table 2 shows the mean values of financing, provision and outcome types of health systems.

When classifying OECD healthcare systems based on their financing characteristics, we found four healthcare system financing types:

1. Switzerland and the United States (US) formed the smallest financing cluster. These countries have the highest level of CHE, the lowest level of government financing and an average share of private out-of-pocket payments.
2. Australia, Austria, Belgium, Canada, Czechia, Denmark, Finland, France, Germany, Iceland, Ireland,

Japan, Luxembourg, the Netherlands, New Zealand, Norway, Slovenia, Sweden, and the United Kingdom (UK) formed the second financing type. This type represents countries that have high level of CHE, the highest share of general government expenditure and the lowest share of private out-of-pocket expenditure.
3. Brazil, Chile, China, Greece, Indonesia, Latvia, Lithuania, Mexico, Portugal, South Korea, and Russia formed the third financing cluster, which represents countries that have the lowest level of CHE, low share of government financing and the highest share of private out-of-pocket payments.
4. Colombia, Costa Rica, Estonia, Hungary, Israel, Italy, Poland, Slovakia, South Africa, Spain, and Turkey formed a financing cluster characterized by low level of CHE, along with average level of out-of-pocket and government expenditure.

As for healthcare system provision we were able to distinguish five different types:

1. Austria, Czechia, Japan, Luxembourg, and South Korea formed the first provision type, which represents countries whose primary health services are mainly organized in the private sector, gatekeeping is non-existent, number of doctors is below average, number of hospital beds is the highest, and the coverage of essential health services is the highest.
2. China, Greece, Iceland, Russia, Sweden, Turkey, and the US formed the second provision type whose healthcare systems have no gatekeeping, an average level of doctors and a below average level of hospital beds. The primary care is organized both in the private and public sector and the coverage of essential health services is average.
3. Indonesia and South Africa formed a cluster characterized by primary health services organized both in the public and private sector, gatekeeping is moderate, the coverage of essential health services, number of doctors and hospital beds are the lowest.
4. Australia, Belgium, Canada, Denmark, Estonia, France, Germany, Hungary, Ireland, Latvia, the Netherlands, New Zealand, Norway, Poland, Slovakia, Switzerland, and the UK formed the fourth provision type. In these healthcare systems the coverage of essential health services is high, gatekeeping is strong to moderate, primary health services are mainly organized in the private sector, and the number of doctors and hospital beds is average.
5. Brazil, Chile, Colombia, Costa Rica, Finland, Israel, Italy, Lithuania, Mexico, Portugal, Slovenia, and Spain formed a cluster characterized by strong gatekeeping, average coverage of essential health services, the highest level of doctors and low level of hospital beds. The primary health services are mainly organized in the public sector or both in public and private sectors.

Looking at healthcare system outcomes, we could identify four different types which vary largely by their sizes. The second cluster contains most of the countries. The outcome types are:

1. Estonia, Hungary, Latvia, Lithuania, Poland, Russia, and Slovakia formed the first cluster. These countries have low maternal mortality ratios and high level of measles-vaccine coverage. In these countries, life expectancy is average, the cancer death rates and difference in life expectancy between men and women are the highest.
2. Australia, Austria, Belgium, Brazil, Canada, Chile, China, Colombia, Costa Rica, Czechia, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Israel, Italy, Japan, Luxembourg, Mexico, the Netherlands, New Zealand, Norway, Portugal, South Korea, Slovenia, Spain, Sweden, Switzerland, Turkey, the UK, and the US formed the second outcome type, characterized by low maternal mortality, and cancer death rates. In these countries, the measles-vaccine coverage is very high,the difference in life expectancy is below average, and life expectancy is the highest
3. Indonesia formed its own individual outcome type cluster which is characterized by the highest maternal mortality ratio, the lowest level of cancer death rates and the smallest difference in life expectancy

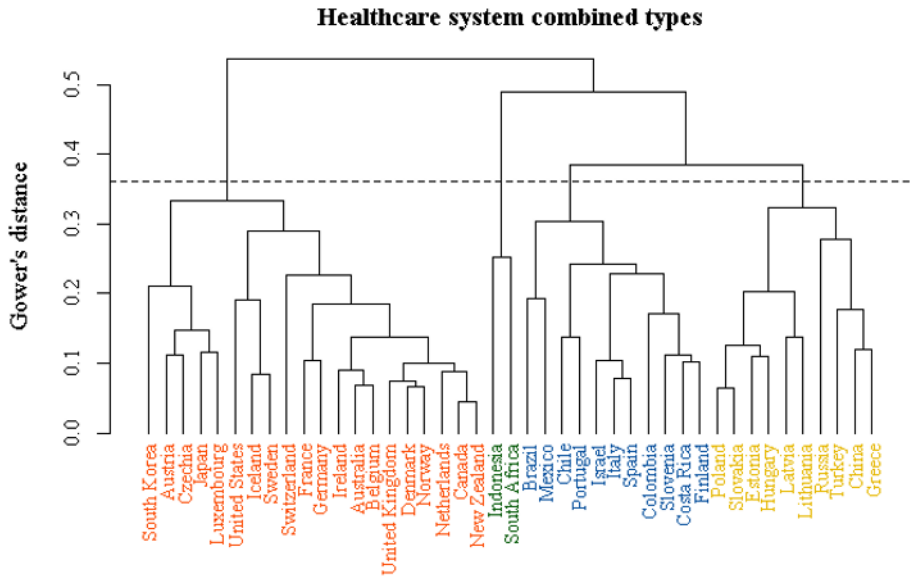

Figure 1a. Dendrogram of healthcare combined types with complete linkage method.

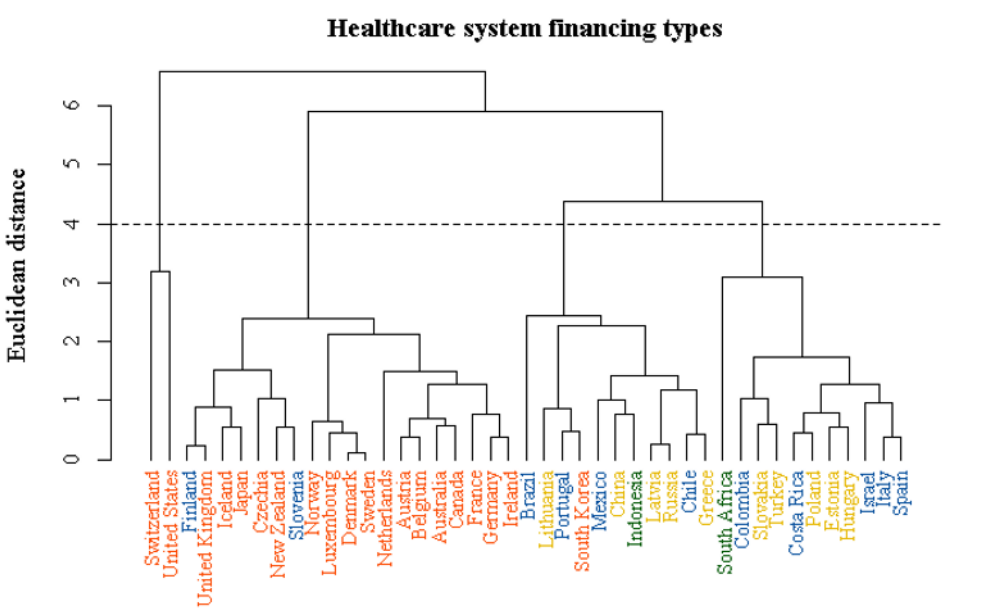

Figure 1b. Dendrogram of healthcare financing types with complete linkage method, colours based on the combined types.

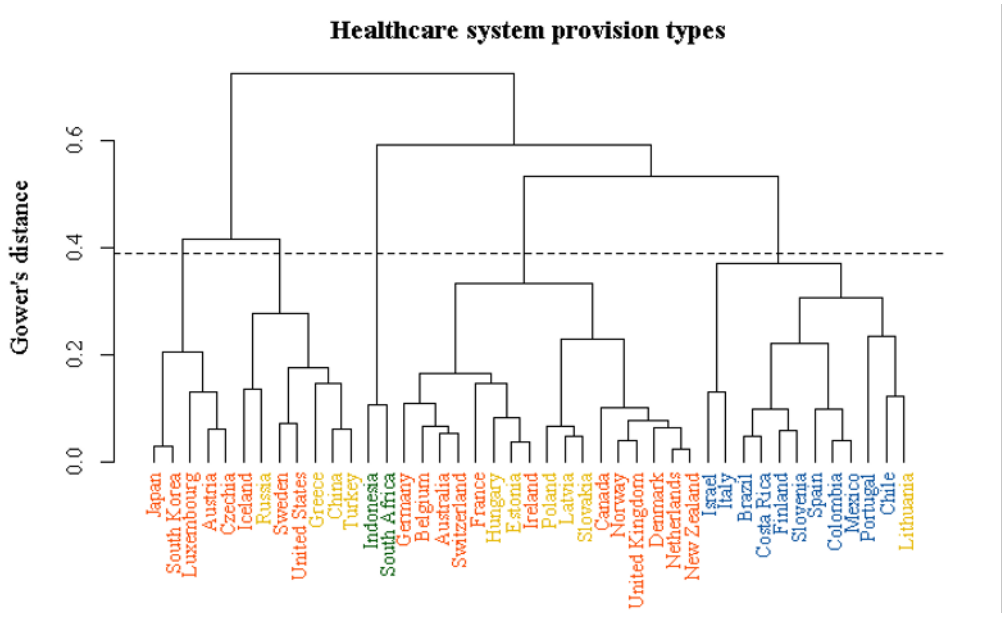

Figure 1c. Dendrogram of healthcare provision types with complete linkage method, colours based on the combined types.

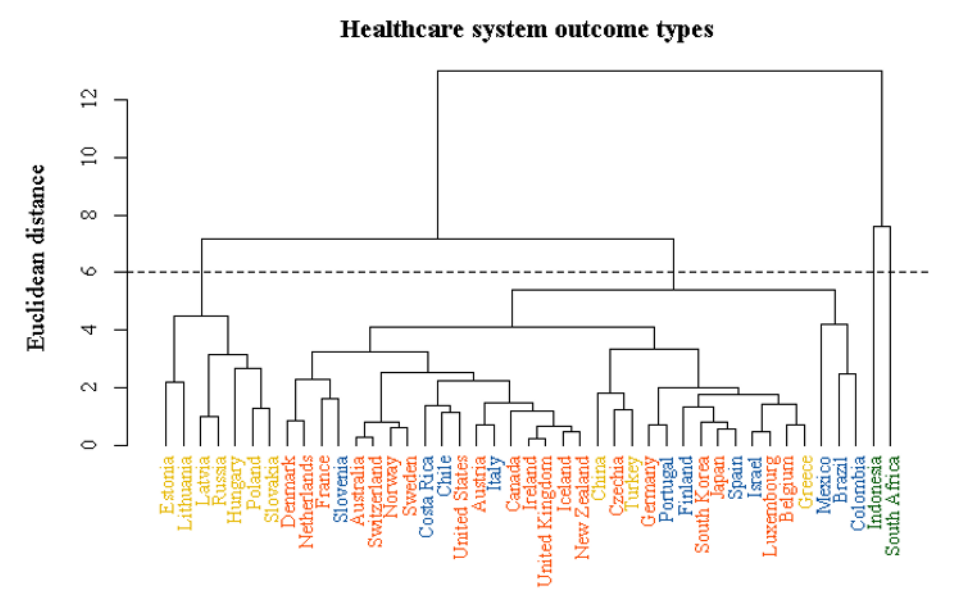

Figure 1d. Dendrogram of healthcare outcome types with complete linkage method, colours based on the combined types.

Table 2. Mean values of healthcare system types of three dimensions.

Healthcare system types	Current health expenditure	Domestic general government health expenditure	Private household out-of-pocket expenditure			Countries
Financing type 1	9,368.9	40.8	19.4			CH, US
Financing type 2	5,146.0	77.6	14.2			AU, AT, BE, CA, CZ, DK, FI, FR, DE, IS, IE, JP, LU, NL, NZ, NO, SI, SE, UK
Financing type 3	1,882.4	55.0	34.7			BR, CL, CN, GR, ID, LV, LT, MX, PT, KR, RU
Financing type 4	2,176.2	70.7	20.1			CO, CR, EE, HU, IL, IT, PL, SK, SA, ES, TR
	Medical doctors	Hospital beds	UHC index	Gatekeeping	Primary healthcare delivery	
Provision type 1	34.3	87.6	81.4	3.0	1.0	AT, CZ, JP, LU, KR
Provision type 2	36.4	37.7	79.6	3.0	2.3	CN, GR, IS, RU, SE, TR, US
Provision type 3	6.1	16.7	63.0	2.0	2.0	ID, SA
Provision type 4	38.6	45.3	81.2	1.5	1.0	AU, BE, CA, DK, EE, FR, DE, HU, IE, LV, NL, NZ, NO, SK, CH, UK
Provision type 5	47.8	29.1	78.1	1.2	2.4	BR, CL, CO, CR, FI, IL, IT, LT, MX, SI, ES, PT
	Measles-vaccine coverage	Maternal mortality ratio	Cancer death rate	Difference in life expectancy between males and females	Life expectancy	
Outcome type 1	94.7	10.3	446.5	8.1	76.2	EE, HU, LV, LT, PL, RU, SK
Outcome type 2	94.9	12.4	319.0	4.5	81.2	AU, AT, BE, BR, CA, CL, CN, CO, CR, CZ, DK, FI, FR, DE, GR, IS, IE, IL, IT, JP, LU, MX, NL, NZ, NO, PT, KR, SI, ES, SE, CH, TR, UK, US
Outlier	89.0	177.0	307.4	3.9	71.3	ID
Outlier	70.0	119.0	366.8	6.1	65.3	SA

between men and women, a below average level of measles-vaccine coverage and life expectancy
4. In addition, South Africa formed its individual outcome type that has the lowest level of measles-vaccine coverage, very high maternal mortality ratios, above average cancer deaths rates, and above average difference in life expectancy and the lowest life expectancy.

Lastly, we combined all the three dimensions into one analysis for which we used all the variables in the data. When we look at the combined version of the three dimensions, we find again a different representation of the classification. Table 3 summarizes the mean values of healthcare system combined types which are:

1. Australia, Austria, Belgium, Canada, Czechia, Denmark, France, Germany, Iceland, Ireland, Japan, Luxembourg, Netherlands, New Zealand, Norway, South Korea, Sweden, Switzerland, the UK and the US formed the first combined healthcare system type. These countries are characterized by the lowest share of out-of-pocket expenditure, the highest level of CHE and government health expenditure. The healthcare employment and resources are on a high level when looking at the average values but the country values vary largely. Primary care is mainly organized in the private sector, but gatekeeping processes vary from strong to low. These countries produce the best health outcomes.
2. Indonesia and South Africa form the second combined type. South Africa and Indonesia have a much lower CHE and share of public health expenditure than the other systems. Also, the measles-vaccine coverage is the lowest and the maternal mortality ratios extremely high. In both countries, the number of doctors and hospital beds are low, the level of UHC index is low, gatekeeping is moderate and primary health services are organized both in private and public sector.
3. Brazil, Chile, Colombia, Costa Rica, Greece, Finland, Israel, Italy, Mexico, Portugal, and Spain formed a cluster that is characterized by high level of out-of-pocket expenditure, below average level of CHE and government health expenditure (except for Finland, Italy and Spain). The provision and outcomes of these health systems vary largely. Nevertheless, the level of medical doctors is high, the amount of hospital beds is below average and UHC index is mainly average or below average. Gatekeeping varies from moderate to low while primary care is organized mainly in the public sector or as a mixture of public and private sector. Health outcomes vary also; for example, maternal mortality ratios are among the lowest in Italy, Spain and Finland and among the highest in Brazil. However, measles-vaccine coverage and life expectancy are on a high level and, the difference in life expectancy is above average. Based on the group average, the maternal mortality ratio is high in relation to the median of all countries, but this is due to a few countries where the rate is very high (Colombia, Mexico).
4. China, Greece, Estonia, Hungary, Latvia, Poland, Slovakia, Slovenia, Russia and Turkey formed the fourth combined type which is characterized by a low level of CHE and UHC index together with average government health expenditure, and number of medical doctors, high out-of-pocket expenditure and number of hospital beds. Gatekeeping varies from strong to low and primary healthcare delivery is mainly private or a mix of public and private sectors. Measles-vaccine coverage and maternal mortality ratios are average, but the cancer death rates and difference in life expectancy are the highest. Life expectancy is average or below average. However, some values vary greatly among these countries, for example the maternal mortality varies from three (Greece) to nineteen (Latvia), and amount of hospital beds from 20.6 (Chile) to 70.1 (Hungary) per 10,000 population.

Combining three dimensions, we obtained diverse clusters that are challenging to interpret in a meaningful way. The clusters contain countries that belong to different financing, provision, and outcome types. Even though, there are countries that cluster into the same types in every type (for example Australia and Belgium or Brazil, Chile, and Mexico), the analysis shows a great variation among the clusters of different healthcare system types.

Table 3. Mean values of healthcare combined system types

Health system characteristics	Combined type 1	Combined type 2	Combined type 3	Combined type 4
Current health expenditure	5,605.5	752.3	2,605.5	1,888.1
Domestic general government health expenditure	73.2	51.7	64.4	66.4
Private household out-of-pocket expenditure	15.5	21.3	24.3	29.0
Medical doctors	38.8	6.1	46.3	36.9
Hospital beds	49.7	16.7	25.9	54.2
UHC index	83.5	63.0	78.5	74.8
Gatekeeping	2.1	2.0	1.2	2.0
Primary healthcare delivery	1.2	2.0	2.5	1.6
Measles-vaccine coverage	94.5	79.5	95.2	95.5
Maternal mortality ratio	6.5	148.0	22.1	12.1
Cancer death rate	320.7	337.1	305.5	419.6
Difference in life expectancy between males and females	4.0	5.0	5.2	7.2
Life expectancy	82.0	68.3	80.5	77.4
Countries	AU, AT, BE, CZ, CH, FR, DE, IS, IE, JP, LU, KR, SE, US, CA, DK,NL, NZ, NO, UK	ID, SA	BR, CL, CO, IL, SI, IT, MX, PT, ES, CR, FI	CN, GR, EE, HU, LV, LT, PL, SK, RU, TR

Discussion

We set out to study if there is a coherent clustering of healthcare systems across the three dimensions. As expected, we did not find such results. When combining all the dimensions into one model, we see that the cluster combinations include countries whose financing, provision and outcomes characteristics differ notably from each other. Similarly, when tracking universal health coverage by using indicators for service coverage, treatment and financial protection, Wagstaff and Neelsen (2020) obtained ambiguous results when they connected the indicators with the share of GDP spent on health and the shares of health spending channelled through non-profit and private insurance.

Our most interesting result derives from examining the differences and similarities between the three clustering solutions. As our analysis showed, some countries' health systems are largely different from most systems that fall more specifically into different health system types. Indonesia, South Africa, Switzerland, and the US stand out from the rest of the countries in terms of financing, provision and/or outcomes. It is important to note the countries that deviate from the others are not solely so-called emerging economies. The US has always been part of the healthcare system classifications even though it differs from its other Western counterparts in terms of private health expenditure and access to care (Schieber, 1987; Moran, 2000; Wendt et al., 2009; Wendt, 2014; Reibling et al., 2019). Along with the US health

system, studies have noted Switzerland focuses the service supply on hospitals and spends great amounts on healthcare while has low public health expenditure (Moran, 2000; Wendt, 2014; Reibling et al., 2019).

Investigating the healthcare system dimensions separately justifies analysing more versatile range of countries, as it helps to explain why some countries end up being outliers and why specific countries group together. In case of Indonesia and South Africa, the provision and health outcomes of their health systems, make them outliers in the healthcare system combined types. Moreover, the analyses outliers can represent hidden healthcare system clusters. When adding more countries into the comparisons we might reveal global healthcare system types that might serve more convincingly as healthcare system ideal types.

Also, it is interesting to compare our results with previous healthcare system classifications. OECD's (Schieber, 1987) classification mainly focused on the financing of healthcare systems and has similarities with ours; we find that the Private Health Insurance's model country, the US, forms a financing cluster together with Switzerland whereas the National Health Service's model countries, Sweden and the UK, and the Social Health Insurance's model countries, Germany and Austria, fall into the same financing type. Wendt (2009) classified health systems based on their financing, provision, and access to care; Health service provision-orientated and Low budget-restricted access type countries resemble our combined types, while Universal coverage-controlled access type countries scatter between two different combined types. Reibling et al. (2019) stated that Austria, Germany, and France form a strong cluster which our results, and previous literature (Wendt, 2014; Wendt, 2009), also support. In addition, we find that Estonia, Hungary, Poland and Slovakia, and Spain and Italy, which form strong clusters according to Reibling et al. (2019), belong to the same clusters in every dimension. As a new observation, our results suggest that South American healthcare systems resemble each other, and they often cluster together with Eastern and Southern European countries.

As well as Wendt (2014), we find that European countries cluster into different healthcare system types. Our results also comply with the views of Burau et al. (2015); we cannot identify one single Southern European or East Asian healthcare system. We find that Spain and Italy cluster together in each of the four different health system types. Burau et al. (2015) describe them to be hybrids of other health systems in Europe. However, our findings indicate that the financing of health systems in Greece and Portugal share more similarities with mainly Eastern European and Southern American countries whose out-of-pocket expenditure are high, CHE and government financing are low while provision/wise, Greece clusters together with countries that have non-existent gatekeeping and low coverage of essential health services whereas Portugal with countries whose gatekeeping is strict and coverage of essential health services is average. Also, Reibling et al. (2019) find close ties between Italy and Spain while Portugal clusters with Northern European countries and New Zealand.

In East Asia, we find that compared to the health financing of China, Indonesia and South Korea, Japan separates from them with a low share of out-of-pocket expenditure, high levels of CHE and government expenditure. However, health service provision is similar in Japan and South Korea, while Indonesia and China differ from them in terms of gatekeeping, level of hospital beds, and coverage of essential health services. Lee et al. (2008) suggest adding a new type of health system to the OECD classification of health systems (Schieber, 1987), called the National Insurance model which is best exemplified by South Korean and Taiwanese health systems, while Kam (2012) propose that East Asian countries might represent two different subgroups of health systems.

What comes to the Northern European countries, we find that their health systems' financing and health outcomes resemble each other but in terms of provision, Sweden and Iceland, and Norway and Denmark belong to the same provision types while Finland stands out as an outlier and differs from Norway and Denmark with public-private-mix of primary healthcare delivery and lower coverage of essential health services, while non-existent gatekeeping separates Sweden and Iceland from the other Nordic countries. Also, other studies have noticed this heterogeneity of the Nordic health systems; for example, Denmark often clusters with Western European countries (Reibling, 2010; Wendt, 2014, Reibling et al., 2019), and Finland with Southern European countries (Reibling, 2010; Wendt, 2009).

When combining all the dimensions into one healthcare system classification, we run the risk of forcing disparate healthcare systems into the same clusters. When taking a closer look at the systems, the countries in the same clusters are dissimilar after all. The further usage of these classifications is challenging because, in the end, interpreting the results is ambiguous because the clusters comprise multitude features. Indeed, as indicated above, the classifications seem to hover between generality and specificity (Burau et al., 2015). This challenge became ever more obvious when we added new countries and geographical diversity to the classification (see Burau, 2012). Our results partly confirmed Toth's (2016) observation about different healthcare systems ending up in the same category, while similar systems end up in different categories. Thus, our results demonstrated a lack of ideal types of healthcare systems (see Böhm et al., 2013; Wendt et al., 2009).

The limitations of this study connect to the data. The HiT reviews are not published in the same year, and in some cases almost ten years had elapsed between the dates of publication. As there were no HiT reviews on five countries, the measures of their primary healthcare provision and gatekeeping are the best available estimates. We chose the outcome dimension measures due to the data availability for all the countries even though other, more subtle healthcare outcome measures exist (Travis et al., 2003). Also in previous studies, data availability concerns guide the selection of countries and indicators (Wendt, 2014; Reibling et al., 2019). Furthermore, Burau et al. (2015) discuss the data comparability issues as the complexity of healthcare systems increases when adding more diverse countries into the classifications.

In interpreting our results, it is necessary to emphasize that they are driven by the availability of indicators. The classification might have changed with selection of different indicators, as also other researchers have noted earlier (Burau et al., 2015; Freeman & Frisina, 2010). However, we based the selected indicators on theoretical considerations and adopted various methods (see Appendix 2) to ensure the robustness and validity of our results. First, we checked the robustness of our results with average linkage method, k-means and k-medoids optimization clustering techniques. We used these methods to compare the stability of the groupings obtained by the complete linkage method. Even though some countries switched their positions in the clusters, the same countries remained mainly together in the results from all clustering methods. Second, we applied the Calinski-Harabasz index and the elbow method to interpret the results of the dendrograms and to determine the final number of clusters (see Everitt et al., 2011). The values of both methods supported our cluster solutions.

Our classification can be used, with the expressed reservations, as a tool for future studies that compare healthcare system performance and effectiveness, and analyse attitudes towards healthcare systems, such as the relationship between healthcare system types and citizens' satisfaction with healthcare. Bearing in mind the risk of oversimplifying the actual systems, the integrated and separated subsystems of healthcare models form an all-encompassing entity that is meaningful to categorize (cf. Toth, 2016). Applying classifications is challenging because of the difficulties to disentangle the way in which the dimensions and variables are connected to the phenomena we are interested in. Separating the dimensions can help us to detect connections between the healthcare system types and phenomena being studied.

Conclusion

In this paper, we classified 43 healthcare systems of OECD countries and selected non-member economies into three different healthcare system types: healthcare financing, provision, and outcomes. The results show that healthcare system dimensions differ from each other and each of them form their unique healthcare system types. The inclusion of all three dimensions in one model lessens the unity of the healthcare system types. Depending on the usage of the classifications, it is relevant to note the implications of combining several dimensions in classifying healthcare systems.

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