DOI: https://doi.org/10.37075/EA.2025.3.14 Economic Alternatives, 2025, Issue 3, pp. 909-926

Efficiency Evaluation of the Healthcare System in Albania

Received: 16.04.2024
Available online: 30.09.2025

Silvana Mustafaj[*], Amalia Tola[**], Elfrida Dishmema[***], Etleva Muça[****]

Abstract

The effectiveness of a country's healthcare system serves as a key metric to assess its economic development, as it directly influences the well-being and life expectancy of its population. The healthcare system is an important sector of great public interest, and as such it is expected to operate efficiently, addressing well and in time people's needs. The paper reveals the findings from the efficiency analysis of the healthcare system in Albania, in terms of public expenditure in healthcare, from 2007 to 2021. Its purpose is to provide a comprehensive view of the system's advancement during this timeframe, identifying the years with efficiency and inefficiency. Additionally, the paper suggests potential applications of the model results, to enhance efficiency in future healthcare management. The assessment of healthcare system efficiency in Albania, is based on the analysis of secondary data, using the nonparametric approach, Data Envelopment Analysis. The results of the analysis indicate fluctuating efficiency levels of the healthcare system over the course of those fifteen years.

In terms of public spending, the healthcare system in Albania proved to be efficient during the years 2008, 2013, and 2015, while it showed levels of inefficiency during the other years including the Covid-19 pandemic.

Keywords: Albanian healthcare, healthcare system efficiency, sustainable development, Data Envelopment Analysis (DEA).

JEL: H51, I18, J41.

1. Introduction

Good health and well-being is one of the key principles of the Sustainable Development Goals (SDGs) 2030, which is directly related to the development process in Albania. With the transition from Millennium Development Goals (MDGs) to Sustainable Development Goals (SDGs), the literature on publicly financed health expenditure (PHE) and health outcomes has attracted the

[*] Department of Mathematics and Informatics, Faculty of Economy and Agribusiness, Agricultural University of Tirana, Albania
[**] Department of Agribusiness Management, Faculty of Economy and Agribusiness, Agricultural University of Tirana, Albania
[***] Department of Mathematics and Informatics, Faculty of Economy and Agribusiness, Agricultural University of Tirana, Albania
[****] Department of Economy and Rural Development Policies, Faculty of Economy and Agribusiness, Agricultural University of Tirana, Albania

attention of researchers and policymakers around the globe, especially in developing countries (Mohanty & Behera, 2023). Ensuring the well-being of individuals and fostering good health across all life stages is crucial for sustainable development (INSTAT, 2023). Healthcare is only one of the 17 objectives of the SDGs, while other goals include a variety of health factors as well, which are not directly connected to goal 3, but continue to be significant (Aftab et al., 2020).

According to Sood et al., (2009) *Healthcare* is the prevention, treatment, and management of illness and the preservation of mental and physical well-being through the services offered by the medical, nursing, and allied health professions. While healthcare deals with the prevention, treatment, and management of illnesses, the healthcare system comprises of people, structures, and actions to achieve good care.

The mostly used definition about a *healthcare system* is the one provided by the World Health Organization (2007) which asserts that a health system "consists of all organizations, people and actions whose primary intent is to promote, restore or maintain health" as well as compensating for permanent disabilities, regardless of whether health agents are public, governmental, nongovernmental, or private (Arteaga, 2014).

Efficiency refers to the extent to which system objectives are met given the resources invested in the system (WHO, 2000 and Mbau et al., 2023).

Attaining efficiency in the healthcare system, aligns with the SDG declaration, 'we must achieve universal health coverage (UHC) and access to quality healthcare. No one must be left behind' (World Health Organization, 2017).

Healthcare is inherently linked to sustainability goals, as it directly impacts the health and welfare of individuals, communities, and the planet. SDG 3, "ensure healthy lives and promote well-being for all at all ages" (WHO, 2024), explicitly acknowledges the significance of healthcare in accomplishing broader sustainability goals. Efficient healthcare systems are better equipped to respond to environmental and public health challenges, such as climate change, pandemics, and natural disasters, which have significant implications for the sustainability of societies.

The healthcare system in Albania consists of primary healthcare, and secondary and tertiary hospital service, as defined by the Ministry of Health and Social Protection in Albania (2023) with the responsibility of ensuring the health and well-being of the country's population. Figure 1 provides an overview of the number of public health institutions in Albania from 2007 to 2021, utilizing the data from the Institute of Statistics of Albania (INSTAT).

Primary healthcare includes the medical service provided in healthcare centers, ambulances, and polyclinics, as well as healthcare consultancy centers for women and the ones for children. Primary healthcare centers include all institutions that provide healthcare to patients on an outpatient basis, and which are equipped with at least one medical staff, being a doctor or nurse (dental service is not included), according to Public Health Indicators (INSTAT, 2021). Primary healthcare services are provided for the population from its basic unit, which is known

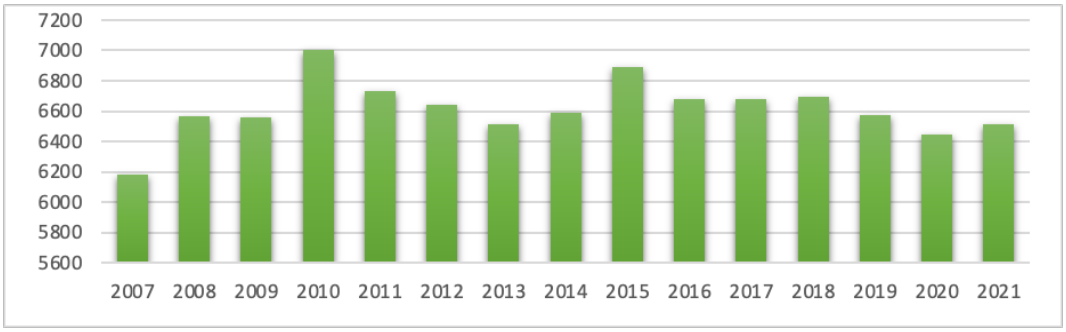

Figure 1. Number of public health institutions in Albania, during 2007-2021.
Source: Developed by the authors based on INSTAT data (2023)

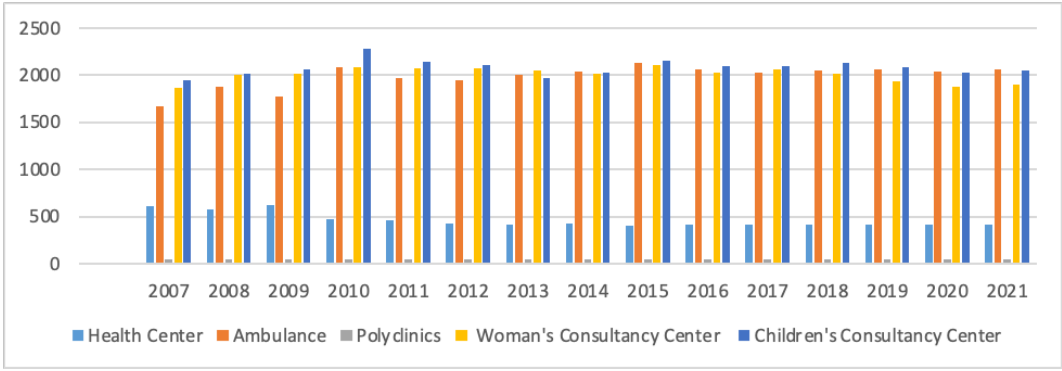

Figure 2. Number of primary healthcare institutions during the 2007-2021 period in Albania
Source: Developed by the authors based on INSTAT data (2023)

as the main healthcare center, on the city level and administrative unit center, and from the ambulance or healthcare point, on the village level. This division aims to achieve the widest possible coverage for the population and in order to access to healthcare services for the population, as the first point of contact with the national healthcare system, according to Public Health Indicators (INSTAT, 2021). Although theoretically the requirements that must be fulfilled by the primary healthcare service are defined, in practical terms, improvements need to be made regarding the infrastructure and healthcare system (Kozak & Muca, 2020). Figure 2 presents the progress in number of all primary healthcare institutions, during the period 2007 till 2021, based on INSTAT data.

The secondary healthcare services are provided through public and non-public hospitals. A hospital is an institutional residence that provides medical care, 24-hour hospitality, diagnosis, treatment, and rehabilitation for patients who may need medical or surgical assistance; a definition provided by Public Health Indicators, INSTAT (2021). The graph presented as Figure 3, shows the number of public hospitals in Albania during the study period from 2007 to 2021.

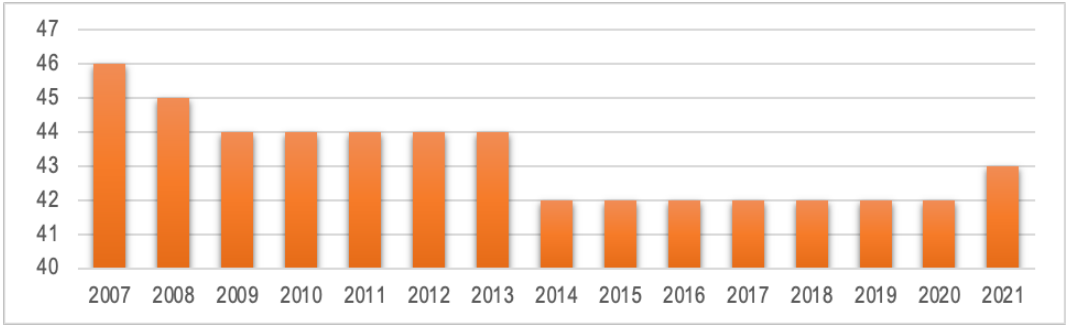

Figure 3. Number of public hospitals during the 2007-2021 period in Albania
Source: Developed by the authors based on INSTAT data (2023)

If we refer to the year 2021, the number of public and non-public (private) hospitals was 59, out of which 43 were public hospitals and 16 were non-public hospitals. Public and non-public hospital service coverage was 2 hospitals per 100,000 inhabitants, and the number of public and non-public hospital beds was 9,363 in total, or 3.3 beds per 1,000 inhabitants (Public Health Indicators, INSTAT, 2021). Access to quality healthcare services is a fundamental human right and a cornerstone of sustainable development, as it contributes to poverty reduction, social inclusion, and economic development. Healthcare efficiency is essential for achieving sustainability goals by optimizing resource utilization and maximizing the value derived from healthcare investments. Efficiency improvements in healthcare, such as reducing waiting times, streamlining administrative processes, and adopting cost-effective interventions, contribute to the sustainability of healthcare systems by enhancing financial resilience and reducing the burden on public resources.

The study contributes novel insights to the discourse on healthcare system efficiency in Albania, a context that has been relatively underexplored in the existing literature. Albania's healthcare system operates within a distinct socioeconomic and political context, characterized by transition, limited resources and unique challenges. The implementation of Data Envelopment Analysis (DEA) in evaluating the efficiency of healthcare systems is not a novel concept in academic research, however, applying this method for evaluating healthcare system efficiency is new for Albania, and therefore contributes to the advancement of knowledge in this field.

The findings of this study offer significant policy implications for healthcare management and policymaking in Albania, as the study provides evidence of the years that have proven to be efficient in terms of public spending in the healthcare system, in a significant timeframe of fifteen years. This extended timeframe allows for the identification of patterns, trends, and shifts in efficiency levels, offering valuable insights into the system's evolution and response to various internal and external factors, which could be taken into consideration in follow-up research.

By specifically examining public expenditure in healthcare, this study zooms in on critical aspects of healthcare financing and resource allocation. Public spending plays a crucial role in shaping the accessibility, affordability, and quality of healthcare services, making it a pertinent area for efficiency analysis. The

study's emphasis on public expenditure adds depth and specificity to the understanding of efficiency dynamics within the Albanian healthcare context.

The article aims to introduce a well-known method for healthcare system efficiency analysis, using publicly available data and identifying potential variables significant for the analysis, based on previous research.

Although the study focuses on the Albanian context, the study addresses a gap in the literature by examining healthcare system efficiency in Albania, a context that has been relatively underexplored in international research. This paper could be beneficial also to a wider audience, as the findings of the research may be used for comparing the results from Albania with healthcare systems in other countries especially those within the same region, or countries with transition economies. International researchers interested in comparative health system analysis, efficiency measurement methodologies, and healthcare reform in transitional economies may find the study's findings and methodology valuable for advancing knowledge in this area.

2. Literature Review

The purpose of the study is to introduce DEA method for healthcare efficiency analysis to the Albanian context, using a period of fifteen years, from 2007 to 2021. Considering the complexity of efficiency in the healthcare system and the objective of the authors to use Data Envelopment Analysis (DEA) as a new approach for Albania, the literature review is focused mainly on identifying previous research using DEA method specifically for healthcare system efficiency analysis, and variables used. Literature review helped to identify different inputs and outputs used by different authors, and therefore facilitate the definition of inputs and outputs that could be applied in the Albanian context, considering the limited availability of public data in this field.

The DEA method has been used quite extensively over time by many researchers, to evaluate the efficiency of the healthcare systems in different countries. This approach is both straightforward and universal, less data-intensive, and can technically handle data gaps (Grochová and Litzman, 2021). Different researchers have employed this method for analyzing healthcare efficiency, utilizing diverse input and output factors, focusing in one specific country or providing analysis across different countries and different time span.

Jung et al., (2023) conducted a comprehensive research of studies that assessed the efficiency of public healthcare systems. For the research they used DEA, as a prominent method for efficiency analysis. The identified studies were grouped according to their research purpose, by Jung et al., (2023), into five types: "Identifying factors affecting efficiencies or analyzing the relationship between efficiencies and key factors; comparing efficiencies between DMUs; analyzing changes in efficiency over time; other public health considerations; and exploring new DEA approaches". They pinpointed distinct DEA methodologies employed in the examined papers. The predominant choice among them was the fundamental DEA model. The basic DEA model is divided into the Charnes-Cooper-Rhodes (CCR) vs. Banker-Charnes-Cooper (BCC) models according to its assumptions related to returns to scale (Charnes et al., 1978; Banker et al., 1984; Jung et al., 2023).

In Jung et al., (2023) identified input factors were categorized into: (1) number of medical

staff, (2) number of beds, (3) number of non-medical staff, (4) costs and expenditures, (5) number of overall staff, (6) assets (e.g., supplies, equipment, infrastructure, etc.), (7) macroeconomic factors (e.g., the population, population covered by medical care, etc.), (8) budgets and investments, (9) number of hospitals and healthcare centers, (10) COVID-19 specific factors". The output factors identified by Jung et al., (2023) were categorized into: (1) number of inpatients (e.g., number of inpatients, number of discharges, etc.), (2) number of outpatients (e.g., number of outpatients, number of visits, etc.), (3) healthcare outcomes (e.g., death rate, life expectancy, survival rate, malnutrition rate, etc.), (4) length of stay and hospitalization, (5) number of surgeries, (6) emergency services, (7) financial factors other than revenue and profit (e.g., EBITDA), (8) bed occupancy rate, (9) counseling and medical consultation, (10) COVID-19 specific factors, (11) revenue and profit, (12) number of hospitals and healthcare centers, and (13) etc." According to Jung et al., (2023), "the studies were divided into multi-country studies and single-country studies. The studies showed variations in the countries analyzed."

In their study, Ahmed et al., (2019), "applied an output-oriented data envelopment analysis (DEA) approach to estimate the technical efficiency of the health systems in Asian countries. The DEA model used per-capita health expenditure (all healthcare resources as a proxy) as input variable and cross-country comparable health outcome indicators (e.g. healthy life expectancy at birth and infant mortality per 1000 live births) as output variables."

Gonzalez-Badillo, and Alarcon-Bernal (2021), in their paper, studied the context of 39 different countries' healthcare systems up to 2019, by applying the output-oriented variable return-to-scale model (VRS) of Data Envelopment Analysis. Four input variables (health expenditure per capita, beds, physicians, and nurses per thousand people) should result in the best output results (life expectancy at birth, death rate per thousand people by communicable and non-communicable diseases, percentage of diabetes prevalence and mortality from cardiovascular diseases, cancer, diabetes or chronic respiratory disease).

Asandului et al. (2014), "presented their work for assessing the efficiency of public healthcare systems in thirty European countries for the year 2010. They applied the input-oriented variable return-to-scale model (VRS) of Data Envelopment Analysis in their research." Asandului et al. (2014), selected three output variables: life expectancy at birth, health adjusted life expectancy, and infant mortality rate and three input variables: number of doctors, number of hospital beds, and public health expenditure as a percentage of GDP.

El Husseiny et al., (2023), in their study utilized the DEA approach to calculate the relative TE scores of healthcare systems in a set of 20 Arab countries, adopting both the input and output orientations. In this study, two variables were chosen as health outputs, namely life expectancy at birth and infant survival rate, based on infant mortality rate per 1,000 live births. Three variables were chosen as inputs of the healthcare systems for the DEA model in that study: the ratio of current health expenditures on GDP; physician density measured as the number of physicians per 1,000 population; and hospital beds density measured as the number of hospital beds per 1,000 population.

Campos-Lucena et al., (2018) made a comparative analysis of the efficiency of the health services of different regions of Spain using the DEA approach. The input variables used are the territorialized public health expenditure per protected inhabitant allocated to the direct support of the citizens; the health expenditure per protected inhabitant, which is allocated to agreements with private firms; and the health expenditure per protected inhabitant which is allocated to the training of resident physicians. Output variables used were the rate of surgical interventions per 1,000 inhabitants per year; the degree of satisfaction of the citizens with the healthcare system; the general mortality rate, adjusted by age per 100,000 inhabitants.

Rutledge et al., (1995), in their study used the DEA methodology and its ability to determine the relative efficiency of each of the 22 months for a mid-sized nonprofit hospital in the Southeast United States. The study contains 22 DMUs (observations) and has five inputs and five outputs. Inputs used are: nursing services, ancillary services, support services, temporary or purchased services, and patient supplies. Outputs used are: the number of cases treated in the diagnostic category for diseases and disorders of the circulatory system.

Dhaoui (2019), in his paper assessed the technical efficiency of 18 healthcare systems in countries of the Middle East and countries in North Africa, in the first stage of a two-stage performance analysis, using the DEA method for the years 1997, 2005 and 2014. Dhaoui used both an input and an output-oriented approach to measure the technical efficiency of those systems. Dhaoui (2019) used three inputs in the research: "health expenditure per capita, measured in terms of the PPP constant; number of physicians per thousand inhabitants; the number of hospital beds per 1000 inhabitants. He selected life expectancy at birth as the key output measurement of a health system outcome".

Popescu et al., (2014), in their paper aimed to assess the efficiency of the European healthcare systems using Data Envelopment Analysis. They used immunization rate and health expenditures as input variables in their research, and survival rate for adults and tuberculosis rate as output variables. The study uses data from the 27 EU member states.

Cylus et al., (2017), in their article, propose a method that relies on DEA to construct composite healthcare system efficiency indicators from several partial efficiency measures. After reviewing the data of 11 European countries from 2005 through 2008, they have chosen the following indicators: consultations per physician; acute care occupancy rate; inverse of average length of stay (ALOS); inverse of health spending share of GDP.

Thabrani et al., (2019) in their study analyzed the efficiency of health services of all district/city governments in West Sumatra using the Data Envelopment Analysis. They used as inputs: the number of doctors, the number of nurses, and the number of inpatient beds, while the outputs used are: life expectancy and the percentage of people who experience health complaints.

Purohit (2016), in his paper focused on the efficiency of the healthcare system at sub-state level (i.e., district level), using data from Gujarat in India from 2012 and 2013. The study explores the reasons for relative performance of different districts using the Data Envelopment Analysis. Purohit used infant mortality rate (IMR) as output variables. As for input variables he used: the availability

of medical and paramedical personnel; capital investment represented by tribal beds, community health centers (CHCs), and sub-divisional hospitals.

In their research, Ramalho et al., (2022), "conducted a two-stage data envelopment analysis (DEA) to assess the technical efficiency of 54 Portuguese primary care health center groupings for the 2016-2017 biennium." In the first stage, efficiency scores were obtained through output-oriented DEA model under variable return to scale (VRS) assumption, using three input variables: the number of medical doctors; the number of resident doctors; and the number of nurses) and one output representing each one of the five Prevention Quality Indicators (PQIs) related to diabetes.

Bahurmoz (1999), used the DEA method to measure the relative efficiency of primary healthcare centers in Jeddah, Saudi Arabia. The study uses outpatients' visits; total number of pregnancy checkups; total number of children who completed the required immunizations for the first year of their age; and other services such as first aid and different types of emergency services as output variables. Full time equivalent hours for physicians (including specialists but excluding dentists); nurses; administrative staff; and for technical staff such as statisticians, pharmacists, nutritionists, were used as input variables.

Chai et al. (2019), examined the efficiency of China's healthcare system, trying to understand the underlying causes of the variation in efficiency across provinces. To analyze the healthcare system efficiency at the provincial level, they included 31 administrative areas in mainland China. Analyses were performed using the bootstrapping data envelopment technique. Health outcomes defined by Chai et al.(2019), were measured by infant survival rates; maternal survival rates; and healthy life years considering non-chronical diseases (NCDs). As for the input, the number of physicians per thousand inhabitants and the number of hospital beds per thousand inhabitants, and the total health expenditure per capita were used in the research of Chai et al., (2019). The model also examined the impact of environmental factors on healthcare system efficiency.

3. Materials and Methods

The research study presented in this paper aims to assess healthcare system efficiency in Albania, from 2007 till 2021. The paper aims to provide answers to the research question:

> *"How has the healthcare system in Albania performed over time, as measured by the Data Envelopment Analysis (DEA) method, and how does it relate to the allocation of public healthcare expenditure as a percentage of the Gross Domestic Product (GDP) as input, and life expectancy at birth and the inverse of the infant mortality rate as output?"*

This research question seeks to explore the efficiency of Albania's healthcare system over the years, by assessing how efficiently resources are utilized relative to the country's GDP expenditure on public healthcare. It also aims to investigate the relationship between healthcare efficiency and key health outcome indicators, namely life expectancy at birth and the inverse of the infant mortality rate. In order to provide answers to the research questions, publicly available data provided by the Institute of Statistics of Albania, and World Bank data on Health Nutrition and Population Statistics have been used.

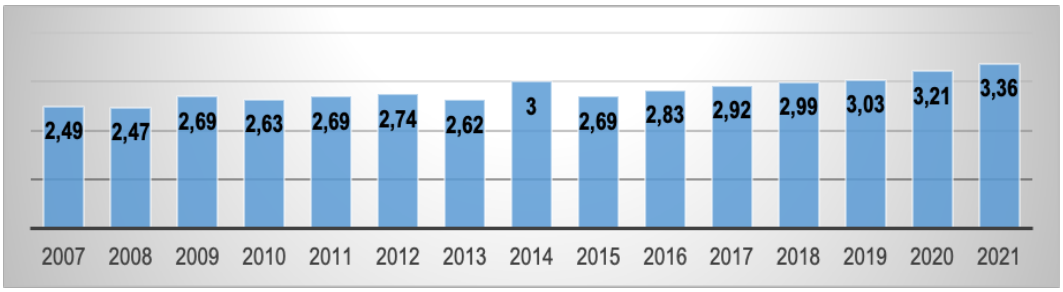

Figure 4. The ratio of public healthcare expenditure in relation to the Gross Domestic Product in Albania

Source: Developed by the authors based on INSTAT data (2023)

The study focuses on evaluating the relative technical efficiency of the healthcare system in Albania, using the DEA method, through the CCR model, developed by Charnes, Cooper and Rhodes (1978). The model is based on mathematical programming to measure, in a relative way, the efficiency of a group of decision-making units (DMU) with common inputs and outputs (Cooper et al., 2004; Higuerey, et al., 2021). Data Envelopment Analysis is a nonparametric approach, which is basically a technique of linear programming (Malik et al., 2018). The input-oriented CCR model (CCR-I) used for the study aims to produce the same output level with the possible minimum of input. The ratio of Public healthcare Expenditure in relation to the Gross Domestic Product (in %, using current expenses and fixed prices), as shown in figure 4, was taken as input in this model.

As specified by the World Health Organization (2024) "the total expenditure on health expressed as a percentage of GDP, where GDP is the value of all final goods and services produced within a nation in a given year, provides information on the level of resources channeled to health, relative to a country's wealth." Public health expenditure per capita and public health expenditure as a percentage of GDP, show the political commitment to health, relative to other public spending (McIntyre & Kutzin, 2016, and Behera et al., 2022).

Life expectancy at birth (total years) and the inverse of the infant mortality rate (per 1,000 live births) were utilized as output variables in the analysis, following the approach outlined by Ahmed et al. in 2019. The empirical result finds that aggregate health expenditure, especially public health expenditure, show positive effects on the improvement in life expectancy and reduction of infant mortality (Behera & Dash, 2020).

These indicators used by the World Bank (2024), are defined as:

- *"Life expectancy at birth* indicates the number of years a newborn infant would live if prevailing patterns of mortality at the time of its birth were to stay the same throughout its life.";
- "*Infant mortality rate (IMR)* is the number of infants dying before reaching one year of age, per 1,000 live births in a given year."

IMR is a crucial indicator of the quality of healthcare and social services in a society. A higher rate typically indicates poorer health outcomes and healthcare access for infants.

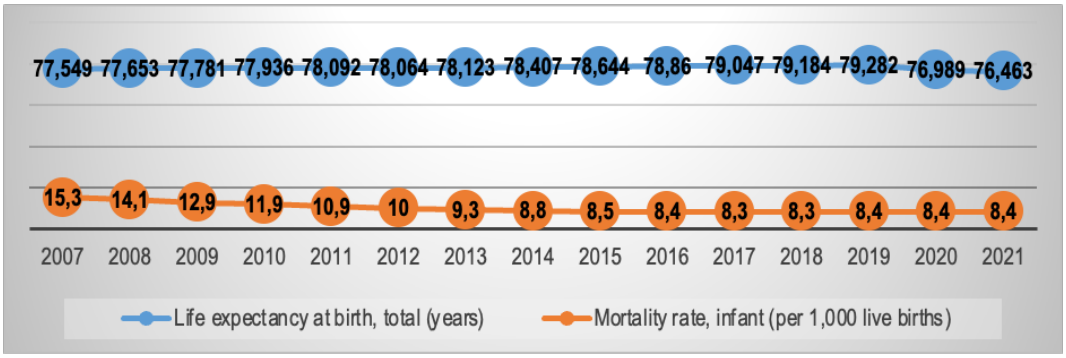

Figure 5. Life expectancy at birth, (total years) and mortality rate, infant (per 1000 live births) in Albania

Source: Developed by the authors based on World Bank (2023)

The "inverse infant mortality rate" represents the opposite trend of the IMR, therefore measures infant health or healthcare quality that is positively associated with better outcomes or lower mortality rates.

The graph presented in Figure 5 shows the data sets for the chosen output variables, respectively, life expectancy at birth (total years) and the infant mortality rate (per 1,000 live births).

As defined by Cooper et al., (2004), "Data Envelopment Analysis is an approach for evaluating the performance of a set of peer entities called Decision Making Units (DMU)". Since this paper aims to assess the efficiency of the healthcare system in Albania during a 15 year time span (2007-2021), 15 DMUs are identified using the period of time, therefore each year, as a DMU for the model; thus enabling the evaluation of the efficiency of a single unit (healthcare system) in relation to itself over time (as in Rutledge et al., 1995). The model determines the years when the healthcare system in Albania proves to be efficient, and the years when the system is found to be inefficient. It thus builds an efficient frontier, in which there will be those years where the healthcare system has been efficient, and below this efficient frontier will be all the years when the healthcare system has been inefficient.

As in Cooper et al. (2004), the CCR-I model, in its envelopment form, under the CRS assumption is provided below.

$$\min\ \theta - \varepsilon\left(\sum_{i=1}^{m} s_i^- + \sum_{r=1}^{s} S_r^+\right)$$

Subject to:

$$\sum_{j=1}^{n} x_{ij}\lambda_j + s_i^- = \theta x_{i0} \qquad i = 1,2,\dots,m$$

$$\sum_{j=1}^{n} y_{rj}\lambda_j - s_r^+ = y_{r0} \qquad r = 1,2,\dots,s$$

$$\lambda_j, s_i^-, s_r^+ \geq 0 \qquad \forall j,i,r$$

where:

- 'n' number of $DMUs$ to be evaluated;
- each DMU have m inputs and produces s outputs;
- a DMU_j consumes x_{ij} of input i and produces y_{rj} of output r;
- λ_j - the weights assigned by the linear program;

- θ - the efficiency score for the j[th] DMU (scalar that determines the proportional reduction for all inputs of DMU);
- s_i and s_r are the input and output slacks;
- ε is a non-Archimedean element smaller than any positive real number.

According to Cooper et al., (2007) "this linear programming problem must be solved 'n' times, once for each in the sample. A rough rule of thumb in the envelopment model is to choose the number of DMUs ('n') equal to or greater than $max\{m\ x\ s, 3\ x\ (m\ +\ s)\}$."

According to Sarkis (2007) and Jung et al. (2023), "the number of DMUs plays an important role in the validity of the analysis in DEA studies. As the number of DMUs increases, the chance of capturing high-performance DMUs, that determine the efficiency frontier also increases, and thus the accuracy of the analysis can be improved". The number of DMUs used in this study is 15, fulfilling therefore the condition required above by the model.

The study relies on limited, publicly available secondary data sources. In our study we have used all the data that could be found, however, if there is a possibility of more data being available later on, both in terms of variables and DMU's, a follow-up study could lead to an expansion in the number of variables and time span for the analysis, thereby offering a more comprehensive insight into healthcare efficiency in Albania.

4. Results and Discussions

After processing the data through the DEAFrontier program, we obtained the results presented below. The results provide valuable insights into the efficiency dynamics of Albania's healthcare system. In the first table, the results of the efficiency of the healthcare system and the values of the slacks variables for the 15 years included in the analysis, are presented.

Table 1. Input-oriented CRS Efficiency, input and output slacks

DMU no.	DMU name	Input-oriented CRS Efficiency	Input Slacks	Output Slacks	
			Ratio of public healthcare expenditure in the relation to the GDP	Life expectancy at birth (in years)	Inverse infant mortality rate (per 1000 live births)
1	Year 2007	0.99064	0.00000	0.00000	0.00547
2	Year 2008	1.00000	0.00000	0.00000	0.00000
3	Year 2009	0.92872	0.00000	0.00000	0.00000
4	Year 2010	0.96083	0.00000	0.00000	0.00000
5	Year 2011	0.95175	0.00000	0.00000	0.00000
6	Year 2012	0.94534	0.00000	0.00000	0.00000
7	Year 2013	1.00000	0.00000	0.00000	0.00000
8	Year 2014	0.88716	0.00000	0.00000	0.00000
9	Year 2015	1.00000	0.00000	0.00000	0.00000
10	Year 2016	0.96185	0.00000	0.72024	0.00000
11	Year 2017	0.94343	0.00000	1.49204	0.00000
12	Year 2018	0.92134	0.00000	1.35504	0.00000
13	Year 2019	0.89836	0.00000	0.29824	0.00000
14	Year 2020	0.84798	0.00000	2.59124	0.00000
15	Year 2021	0.81013	0.00000	3.11724	0.00000

Source: Developed by the authors

The DEA results are derived from the data on the inputs and outputs of the healthcare system for the 2007 to 2021 period, and provide measures of relative technical efficiency. Table 1 reveals that the healthcare system in Albania demonstrated to be efficient in 2008, 2013 and 2015, as evidenced by efficiency scores equal to 1 (one) in these respective years. Therefore, out of the 15 years examined in this analysis, regarding the healthcare system efficiency, only in these three years the system has proven technically efficient, establishing therefore the efficiency frontier. The healthcare system has attained a result of relative technical efficiency equal to 1, with slacks variables equal to zero, so it has been completely technically efficient in 2008, 2013 and 2015. Therefore, there is no year in the study timespan on which the healthcare system in Albania shows weak efficiency.

Notably, the system demonstrated efficiency, for these years where the healthcare system operated at optimal levels of performance, achieving full technical efficiency and establishing the efficiency frontier. However, it is crucial to note that these years are the exceptions rather than the norm, with the majority of the study period characterized by inefficiency.

Observing Table 1, it is apparent that in all remaining years, the healthcare system is inefficient as the efficiency results are below 1 and fall beneath the efficient frontier. Of particular interest is the impact of the Covid-19 pandemic on the efficiency of Albania's healthcare system. During these years, the healthcare system in Albania does not achieve optimal levels of performance. The years 2019, 2020 and 2021, belong to the period of Covid-19, and are also part of the group of years during which the system has proven to be inefficient. During these three years, the healthcare system achieved efficiency results of 0.89836, 0.84798 and 0.81013, respectively, which are among the lowest results of all the years (except for 2014, where this result is 0.88716). Certainly, a significant part of the inefficiency observed during these years is certainly influenced by the severe public health crisis caused by the Covid-19 pandemic, and can be attributed, at least in part, to the unprecedented challenges and disruptions posed by the Covid-19 pandemic, such as putting a strain on healthcare resources, increased demand for healthcare services, supply chain disruptions, and workforce shortages.

Table 2, provides information from the DEA model, showing the reference sets for each year, and the respective optimal lambdas. The reference sets for the years when the healthcare system has proved inefficient consist of groups of years which have proved efficient in this analysis (respectively 2008, 2013 and 2015).

Table 3, provides from the DEA model, the target values of the inputs and outputs of the healthcare system, for all the years included in the analysis. The values of inputs and outputs for the three years which result to be efficient do not change. For all other inefficient years, the values that the inputs and outputs should have, for the healthcare system to be considered fully efficient, are provided in table 3.

As from the results provided in table 1, for all those years that the healthcare system has been inefficient, shows a way of improving their efficiency, by first going through the proportional reduction of inputs with the corresponding efficiency value and then adjusting input and output values by the values of slacks variables. To illustrate this, for the inefficient year 2009 to have

Table 2. Optimal lambdas with benchmarks

DMU no.	DMU name	Input-oriented CRS Efficiency	Optimal Lambdas with Benchmarks			
1	Year 2007	0.99064	0.999	Year 2008		
2	Year 2008	1.00000	1.000	Year 2008		
3	Year 2009	0.92872	0.821	Year 2008	0.179	Year 2013
4	Year 2010	0.96083	0.646	Year 2008	0.355	Year 2013
5	Year 2011	0.95175	0.438	Year 2008	0.564	Year 2013
6	Year 2012	0.94534	0.207	Year 2008	0.793	Year 2013
7	Year 2013	1.00000	1.000	Year 2013		
8	Year 2014	0.88716	0.391	Year 2013	0.608	Year 2015
9	Year 2015	1.00000	1.000	Year 2015		
10	Year 2016	0.96185	1.012	Year 2015		
11	Year 2017	0.94343	1.024	Year 2015		
12	Year 2018	0.92134	1.024	Year 2015		
13	Year 2019	0.89836	1.012	Year 2015		
14	Year 2020	0.84798	1.012	Year 2015		
15	Year 2021	0.81013	1.012	Year 2015		

Source: Developed by the authors

Table 3. Efficient input target

DMU no.	DMU name	Efficient Input target	Efficient Output target	
		The ratio of public healthcare expenditure in relation to the GDP	Life expectancy at birth (total years)	Inverse of infant mortality rate (per 1000 live births)
1	Year 2007	2.46669	77.54900	0.07083
2	Year 2008	2.47000	77.65300	0.07092
3	Year 2009	2.49826	77.78100	0.07752
4	Year 2010	2.52698	77.93600	0.08403
5	Year 2011	2.56020	78.09200	0.09174
6	Year 2012	2.59023	78.06400	0.10000
7	Year 2013	2.62000	78.12300	0.10753
8	Year 2014	2.66147	78.40700	0.11364
9	Year 2015	2.69000	78.64400	0.11765
10	Year 2016	2.72202	79.58024	0.11905
11	Year 2017	2.75482	80.53904	0.12048
12	Year 2018	2.75482	80.53904	0.12048
13	Year 2019	2.72202	79.58024	0.11905
14	Year 2020	2.72202	79.58024	0.11905
15	Year 2021	2.72202	79.58024	0.11905

Source: Developed by the authors

reached efficiency, the reduction in public expenditures equivalent to its efficiency value (0.92872), would be necessary. Moreover, to move closer to full efficiency, improvements should have been made in relation to inputs and outputs determined by slacks variables. But, for this year, the slacks variables are zero, which means that there is no room for further improvements. If we refer to the year 2016, which is also an inefficient year, the

first step towards full efficiency would be to reduce public expenditures by the value of its efficiency (0.96185), and in the second step there is room for further improvement of its first output, which is life expectancy at birth, (total years), increasing it by 0.72024 years with the aim of achieving full technical efficiency.

The results of these improvements in inputs and outputs, for all the years that the healthcare system has been inefficient, are provided in Table 3. The reference sets in Table 2, for each year when the healthcare system has been inefficient, show the way in which any inefficient year can be projected into the efficient frontier and ultimately turn out to be fully efficient. For example, on 2009, which is an inefficient year, we have the reference set consisting of two efficient years, 2008 and 2013. If the inputs and outputs of these two years were to be linearly combined with the optimal lambdas, respectively, 0.821 and 0.179, an efficient unit would be obtained. The same process would take place for 2016, taking the efficient year 2015 as the reference set. The results of these projections for all the years that the healthcare system has been inefficient are provided in table 3. As a conclusion, the results of table 3 are achieved through both ways, which show how an inefficient unit can become fully efficient. Thus, in order for the year 2009 to be fully efficient, the values of inputs and outputs should be at the levels of 2.49826, 77.78100 and 0.07752 respectively for the ratio of public healthcare expenditure in relation to the GDP, life expectancy at birth and inverse of infant mortality rate in comparison to the existing levels which are respectively 2.69, 77.781 and 0.077519.

Similarly, in 2016, the figures ought to be 2.72202, 79.58024, and 0.11905 respectively, for the ratio of public healthcare spending relative to GDP, life expectancy at birth, and the inverse of the infant mortality rate, as opposed to the current values of 2.83, 78.86, and 0.119048.

5. Conclusions

The DEA method, in addition to identifying efficiency results, also provides information on opportunities for improving

The DEA method has proven beneficial for analyzing the efficiency of the healthcare system, providing results in terms of efficiency in the past years as well as ways on how inputs and outputs can interact for the system to reach the efficiency. The interventions for improvements shown by the method, refer to past years which currently cannot be changed, however they can serve as important indicators for future forecasts of the performance of the healthcare system, with the aim to achieve optimal utilization of available resources in order to reach maximum levels of efficiency, therefore contributing to the development of policies in the healthcare sector.

By identifying efficient and inefficient years, the study lays the groundwork for targeted interventions, policy reforms, and resource allocation strategies aimed at enhancing efficiency and improving healthcare delivery outcomes in the country.

The results suggest that the inefficiencies observed in Albania's healthcare system may be influenced by a combination of factors, including but not limited to, resource constraints, organizational inefficiencies, and external shocks such as public health crises. While the DEA method provides insights into relative technical efficiency, further analysis is needed to identify the specific determinants driving inefficiencies within the healthcare system. Factors such as inadequate

infrastructure, limited access to healthcare services, inefficient use of healthcare resources, and governance challenges, including the concept of fiscal space for healthcare, may need closer examination and future research.

Understanding the determinants of healthcare system inefficiency is crucial for informing evidence-based policy interventions aimed at improving system performance and resilience. Addressing inefficiencies within the healthcare system requires a multi-faceted approach that addresses both supply-side and demand-side factors. Strategies such as investment in healthcare infrastructure, workforce development, technology adoption, and health system governance reforms may help enhance efficiency and mitigate the impact of external shocks such as the Covid-19 pandemic. Additionally, strengthening healthcare delivery systems, promoting preventive care, and fostering collaboration between public and private sector stakeholders, is essential for building a more efficient and resilient healthcare system in Albania.

In summary, this study represents a novel contribution to the literature on healthcare system efficiency assessment by applying the DEA method to the context of Albania. Through its contextual relevance, methodological adaptations, and policy implications, this research advances our understanding of healthcare efficiency dynamics in transitional settings and provides valuable insights for improving healthcare delivery and management practices in Albania and beyond.

The findings from the DEA method analysis provide valuable insights into the efficiency dynamics of Albania's healthcare system, highlighting periods of efficiency and inefficiency, the impact of external shocks such as the Covid-19 pandemic, and potential determinants of inefficiency. Further analysis and policy interventions are needed to address these inefficiencies and enhance the performance and sustainability of Albania's healthcare system in the future.

References

Aftab, W., Siddiqui, F.J., Tasic, H., Perveen, S., Siddiqi, S., & Bhutta, Z.A., 2020. Implementation of health and health-related sustainable development goals: progress, challenges and opportunities – a systematic literature review. *BMJ Global Health 5*. DOI:10.1136/ bmjgh-2019-002273.

Ahmed, S., Hasan, M. Z., MacLennan, M., Dorin, F., Ahmed, M. W., Hasan, M. M., Hasan, S. M., Islam, M. T., & Khan, J. A. M., 2019. Measuring the efficiency of health systems in Asia: a data envelopment analysis. *BMJ Open,* 9(3).

Doi:10.1136/bmjopen-2018-022155

Arteaga, O. (2014). Health Systems. In: Michalos, A.C. (eds) Encyclopedia of Quality of Life and Well-Being Research. Springer, Dordrecht. Doi:10.1007/978-94-007-0753-5_3390

Asandului, L., Roman, M., & Fatulescu, P. (2014). The efficiency of healthcare systems in Europe: A data envelopment analysis approach. *Procedia Economics and Finance*, 10, 261–268. Doi:10.1016/S2212-5671(14)00301-3

Bahurmoz, A.M.A., 1999. Measuring Efficiency in Primary healthcare Centres in Saudi Arabia. *Journal of King Abdulaziz University-Economics & Administration*, Vol. 12, No. 2, pp. 3-18.

Banker, R.D.; Charnes, A.; Cooper, W.W. Some Models for Estimating Technical and Scale Inefficiencies in Data Envelopment

Analysis. *Management Science* 30(9):1078-1092. Doi:10.1287/mnsc.30.9.1078

Behera, D. K., Dash, U. (2020). Is health expenditure effective for achieving healthcare goals? Empirical evidence from South-East Asia Region. *Asia-Pacific Journal of Regional Science* 4, 593–618. Doi:10.1007/s41685-020-00158-4

Behera, D.K., Dash, U., Sahu, S.K. (2022). Exploring the possible sources of fiscal space for health in India: insights from political regimes. *Health Research Policy and Systems* 20, 32. Doi:10.1186/s12961-022-00831-4

Campos-Lucena MSS-D, Sanz Diaz MT, Morente FV, Ovando RY. The efficiency of health services in Spain based on Data Envelopment Analysis (DEA). The singularity of health efficiency. *International Journal of Collaborative Research on Internal Medicine & Public Health* 2018; 10(1): 776–791.

Chai P, Zhang Y, Zhou M, et al., 2018. Technical and scale efficiency of provincial health systems in China: a bootstrapping data envelopment analysis. *BMJ Open* 2019; 9:e027539.

Doi:10.1136/bmjopen-2018-027539

Charnes, A., W. W. Cooper, A. Y. Lewin and L. M. Seiford, 1994. Data Envelopment Analysis: Theory, Methodology and Applications. Kluwer Academic Publishers.

Charnes, A., Cooper, W.W., Rhodes, E., 1978. Measuring the efficiency of decision making units, *European Journal of Operational Research*, Volume 2, Issue 6, 429-444. Doi:10.1016/0377-2217(78)90138-8.

Coelli, T., 1996. A guide to DEAP version 2.1: a data envelopment analysis (computer) program. Centre for Efficiency and Productivity Analysis, University of New England, Australia, 96(08), 1-49. Available: https://www.owlnet.rice.edu/~econ380/DEAP.PDF [Accessed 25 October 2023]

Cooper, W.W., Seiford, L.M., Zhu, J., 2004. Data Envelopment Analysis. In: Cooper, W.W., Seiford, L.M., Zhu, J. (eds) Handbook on Data Envelopment Analysis. *International Series in Operations Research & Management Science*, vol 71.

Doi:10.1007/1-4020-7798-X_1

Cooper, W.W., Seiford, L.M. and Tone, K., 2007. Data Envelopment Analysis: A Comprehensive Text with Models, Applications, References and DEA-Solver Software. 2nd Edition, Springer, New York.

Cylus, J., Papanicolas, I. and Smith, P.C. (2017), Using Data Envelopment Analysis to Address the Challenges of Comparing Health System Efficiency. *Global Policy*, 8: 60-68. Doi:10.1111/1758-5899.12212

Dhaoui, I., 2019. Healthcare system efficiency and its determinants: a two-stage data envelopment analysis (DEA) from MENA countries. Working Paper No. 1320, Economic Research Forum. Available: https://erf.org.eg/publications/healthcare-system-efficiency-and-its-determinants-a-two-stage-data-envelopment-analysis-dea-from-mena-countries-2/ [Accessed 28 October 2023]

El Husseiny, I. A., 2023. The efficiency of healthcare systems in the Arab countries: a two-stage data envelopment analysis approach. *Journal of Humanities and Applied Social Sciences*, 5(4), 339-358.

Doi:10.1108/JHASS-10-2021-0168.

Gonzalez-Badillo, I.V., Alarcon-Bernal, Z.E., 2021. Performance Evaluation of healthcare Systems Using Data Envelopment Analysis. ICST Institute for Computer Sciences, Social Informatics and Telecommunications Engineering 2021, Published by Springer Nature Switzerland AG 2021. LNICST 393, pp.162–173,2021. DOI: 10.1007/978-3-030-87495-7_11.

Higuerey A, Viñan-Merecí C, Malo-Montoya Z, Martínez-Fernández V-A., 2020. Data Envelopment Analysis (DEA) for Measuring the Efficiency of the Hotel Industry in Ecuador. *Sustainability*, 12(4), 1590. Doi:10.3390/su12041590

INSTAT, 2023. Sustainable development goals: Albania 2022. Institute of Statistics of Albania. Available: https://www.instat.gov.al/media/11278/sdg-2022-en.pdf [Accessed 15 August 2023]

INSTAT, 2023. Statistical Database, Institute of Statistics of Albania. Available: http://databaza.instat.gov.al/pxweb/sq/DST/

[Accessed 10 August 2023].

INSTAT 2021. Treguesit e Shëndetit Publik. Institute of Statistics of Albania. Available: www.instat.gov.al/al/temat/kushtet-sociale/shëndetësia/publikimet/2022/treguesit-e-shëndetit-publik-2021/. [Accessed 15 August 2023]

Jung S, Son J, Kim C, Chung K., 2023. Efficiency Measurement Using Data Envelopment Analysis (DEA) in Public Healthcare: Research Trends from 2017 to 2022. *Processes,* 11(3):811.

Doi:10.3390/pr11030811.

Kozak S., Muça E., 2020. Is the European Union membership a sufficient factor to improve the level of regional development? The case of Albania and voivodeships in Poland, *The Małopolska School of Economics in Tarnów Research Papers Collection*, 2,13–27.

Doi:10.25944/znmwse.2020.02.1327.

Grochová, L.I., Litzman, M., 2021. The efficiency in meeting measurable sustainable development goals. *International Journal of Sustainable Development & World Ecology*. 28. 1-11.

Doi:10.1080/13504509.2021.1882606

Malik M., Efendi S., Zarlis M., 2018. Data Envelopment Analysis (DEA) Model in Operation Management. IOP Conf. Ser.: Mater. Sci. Eng. 300 012008, IOP Publishing Ltd. Doi:10.1088/1757-899X/300/1/012008.

Mbau R, Musiega A, Nyawira L, Tsofa B, Mulwa A, Molyneux S, Maina I, Jemutai J, Normand C, Hanson K, Barasa E., 2023. Analyzing the Efficiency of Health Systems: A Systematic Review of the Literature. *Applied Health Econonomics and Health Policy.* 21(2):205-224. Doi: 10.1007/s40258-022-00785-2.

McIntyre, D., Kutzin, J., 2016. Health financing country diagnostic: a foundation for national strategy development Geneva: World Health Organization; 2016 (Health Financing Guidance No. 1).

Ministry of Health and Social Protection of Albania, 2023. Organization of health system. Available: https://shendetesia.gov.al/organizimi-i-sistemit-shendetesor/ [Accessed 10 August 2023]

Mohanty, R. K., Behera, D. K., 2023. Heterogeneity in health funding and disparities in health outcome: a comparison between high focus and non-high focus states in India. *Cost Effectiveness and Resource Allocation* 21, 44.

Doi:10.1186/s12962-023-00451-x

Popescu, C., Asandului, L., Fatulescu, P., 2014. A Data Envelopment Analysis for Evaluating Romania's health System. *Procedia - Social and Behavioral Sciences*, 109, 1185 – 1189.

Purohit, B. C., 2016. Healthcare sector efficiency in Gujarat (India): an exploratory study using data envelopment analysis. *Healthcare in Low-Resource Settings*, 4(1). Doi:10.4081/hls.2016.5525

Ramalho A, Souza J, Castro P, Lobo M, Santos P, Freitas A., 2022. Portuguese

Primary Healthcare and Prevention Quality Indicators for Diabetes Mellitus - A Data Envelopment Analysis. *International Journal of Health Policy and Management*; 11(9):1725-1734. Doi:10.34172/ijhpm.2021.76.

Rutledge, R., Parson, S., Knaebel, R., 1995. Assessing hospital efficiency over time: an empirical application of data envelopment analysis. *Journal of Information Technology Management,* 4(1), 13-23. Available: http://jitm.ubalt.edu/VI-1/article2.pdf [Accessed 25 July 2023]

Sarkis, J., 2007. Preparing Your Data for DEA. In: Zhu, J., Cook, W.D. (eds) Modeling Data Irregularities and Structural Complexities in Data Envelopment Analysis. Springer, Boston, MA.

Doi:10.1007/978-0-387-71607-7_17

SP Sood, S Keeroo, VWA Mbarika, N Prakash, 2008. . A Seth, Medical Informatics: 36 Peer-reviewed Shades, Handbook of Research on Medical Informatics and eHealth, (Eds.) Athina Lazakidou & Konstantinos M. Siassiakos, Publishers Idea Group Inc. (USA), 1-16.

Thabrani, G., Irfan, M., Mesta, H. A., Arifah, L., 2019. Efficiency Analysis of Local Government Health Service in West Sumatra Province Using Data Envelopment Analysis (DEA). *Advances in Economics, Business and Management Research*, Volume 65.

World Bank, 2023. Health Nutrition and Population Statistics, Data Bank, 2023. Available: https://databank.worldbank.org/source/health-nutrition-and-population-statistics [Accessed 12 August 2023]

World Bank, Metadata Glossary. Available: https://databank.worldbank.org/metadataglossary/world-development-indicators/series/SP.DYN.LE00.IN [Accessed 05 January 2024]

World Health Organization, 2017. Background paper for the regional technical consultation on: Monitoring the Health-Related Sustainable Development Goals (SDGs), SEARO, New Delphi, India. Available: https://www.who.int/docs/default-source/searo/hsd/hwf/01-monitoring-the-health-related-sdgs-background-paper.pdf?sfvrsn=3417607a_4. [Accessed 05 January 2024]

World Health Organization, 2007. Everybody's business: Strengthening health systems to improve health outcomes: WHO's framework for action. WHO, Geneva, Switzerland. Available: https://iris.who.int/bitstream/handle/10665/43918/9789241596077_eng.pdf?sequence=1 [Accessed 10 January 2024]

World Health Organization, 2000. The World Health Report 2000. Health systems: improving performance.

Available:https://www.who.int/publications/i/item/924156198X [Accessed 10 January 2024]

World Health Organization 2024. Nutrition Landscape Information System, Health expenditure. Available: https://www.who.int/data/nutrition/nlis/info/health-expenditure#:˜:text=Total%20expenditure%20on%20health%20as,nation%20in%20a%20given%20year. [Accessed 08 January 2024]

World Health Organization. Sustainable Development Goals, Targets of Sustainable Development Goal 3. Available: https://www.who.int/europe/about-us/our-work/sustainable-development-goals/targets-of-sustainable-development-goal-3 [Accessed 06 January 2024]