Review Paper

Status Quo Of Healthcare Systems and Their Impact on Pharmaceutical Industry Performance in African Developing Countries: A Scoping Review

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ABSTRACT

Economic and political/governmental infrastructural factors are major contributors to the economic development/growth of all sectors of a country, such as in the area of healthcare systems and clinical research, including the pharmaceutical industry. But what is the interaction between economic, and political/governmental infrastructural factors and the development of healthcare systems, especially, the performance of the pharmaceutical industry?
Information from selected articles of a literature search of PubMed and by using Google Advanced Search led to the generation of five categories of infrastructural factors, and were filled with data from 41 African Countries using the World Health Organization data repository. Median changes over time were given and tested by Wilcoxon signed-rank test and Friedman test, respectively.
Analysis of factors related to availability of healthcare facilities showed that physicians and pharmacies were significant increased, with insignificantly decreased number of hospital beds. Healthcare Financing by the Government showed notable differences. Private health spending decreased significantly unlike Gross National Income. Analysis of infrastructural factors showed that stable supply of electricity and the associated use of the Internet improved significantly. The low level of data on the expansion of paved road networks suggests less developed medical services in remote rural areas.
Healthcare systems in African countries improved over the last two decades, but differences between the individual countries still prevail and some of the countries cannot yet offer an attractive sales market for the products of pharmaceutical companies.

Keywords: African countries, Economic and political/governmental infrastructural factors, healthcare systems, clinical research, performance of the pharmaceutical industry.

Introduction

The level of development of a country is mainly reflected by its economic performance. A large contribution to this economic development is made by the country's infrastructure [1]. In the economic sense, the term infrastructure stands for the establishment of companies and structures through which diverse goods can be produced and trade transactions can be conducted in various

areas of the economy [1]. However, in the political or governmental sense, the term encompasses various infrastructural factors, such as transportation systems, power and water supply, information technology, mechanised agricultural, and public sectors such as healthcare systems, and security among others [1]. These infrastructural factors contribute substantially to serving the country's population and play a major role in a country's economic development [1]. A diverse economy warrants a multi-sectoral investment for infrastructural development to guarantee availability of goods and services that makes a country self-reliant. The intersectoral connection of a nation's economy implies that as infrastructure in one sector develops, it enhances the growth of other related sectors. If the expansion of above infrastructural factors influences multisectoral socioeconomic outcomes then an impact could also be assumed in the area of healthcare systems and clinical research, including the pharmaceutical industry [2-4]. This relationship is particularly evident when a natural event occurs, such as a flood disaster. Here, the population of the affected region not only loses their property, but the entire infrastructure and economy are immensely damaged. This causes a collapse in medical care and the risk of waterborne disease outbreaks such as cholera, rotavirus or typhoid increases sharply [5].

Fundamental infrastructural deficiencies commonly found in developing African countries such as poor road networks [6-7], should be contributory to limited access to healthcare, and a shortage of medical personnel in locations of need which are significant barriers to healthcare services. Thus, when Falchetta *et al* advocated a prioritization of the medical infrastructure by the responsible decision makers as a necessary basis to equalize the existing inequality of medical care between the individual countries [8], it should also imply a consideration for multisectoral development. This vision was aptly captured by in the Millennium Development Goal (MDG), adopted by the United Nations Millennium Assembly in 2000 of which the eighth goal states that access to affordable essential medicines in developing countries should be provided in collaboration with pharmaceutical companies to reduce extreme diseases [9]. This implies also an investment in local infrastructural development that will support the operations of pharmaceutical industries. Invariably, infrastructural factors, such as the expansion of the road network or the connection to a stable electricity supply, could probably play a significant role in the attractiveness of the national sales market for pharmaceutical companies, since comprehensive medical care with distribution of the corresponding medical products can only reach rural regions, for example, if there is a good road connection to these regions.

But the question is: what conditions do pharmaceutical companies need in emerging African countries in order to offer their products there and contribute to comprehensive medical care for the population? An answer should include availability of hospitals/medical care facilities and the need for pharmacies to be set up so that the products can be prescribed and dispensed to the population [10]. However, there is also a cost factor which is contingent on the willingness of governments to provide financial security for healthcare. Contrary to this expectation, many government systems in African countries hardly cover the costs of medical care, and thus a large part of the healthcare costs are met by out-of-pocket expenditure. This contradicts the marketing strategy of pharmaceutical companies, which is usually economically-oriented, to offer their products as profitably as possible.

Methodology

To understand the basic interaction between infrastructural factors and the economic development of a country, a scoping review was conducted according to the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA statement) flow diagram [11].

Information Sources and Search strategy:

Literature on the interaction between infrastructural factors and the economy was first searched in the PubMed database and Google Advanced Search. Relevant search terms were identified by checking through the National Library of Medicine Database and, further, by going over a recent review of infrastructural relationship with healthcare system development. The search term "How businesses are affected by infrastructure" was used. Other specific keywords and MeSH terms utilised in the search include (but are not limited to) African countries, Economic and

political/governmental infrastructural factors, healthcare systems, clinical research, performance of the pharmaceutical industry etc., and implementation outcomes such as transportation systems, power and water supply, information technology, and mechanised agricultural development, healthcare systems development, clinical research, performance of the pharmaceutical industry, healthcare financing by the government (both general government healthcare and per capita healthcare expenditures). Additionally, recent narrative reviews, systematic and meta-analytic reviews of infrastructural development, clinical research development and performance of pharmaceutical industry in Africa were scanned for relevant citations. Filters such as free full-text availability, limitation of publication period, and article language only were applied to reduce the number of search results. The final search was limited to articles published in English language within the last 5 years. In addition, a search of the World Wide Web was performed via Google Advanced Search using the same search term. This search was also limited to articles published in English language between January 1, 2017, and November 30, 2021. The literature selected using PubMed and Google Advanced Search was screened by review of title and abstract. After exclusion of duplicates, articles that appeared to be thematically appropriate according to the abstract were subjected to full text review by the author. Articles that included any potential relationship between economic and political or governmental infrastructural factors and economic performance were retained. The search strategy according to the PRISMA statement is presented in Figure 1.

Based on information of the final reviewed articles, five categories of infrastructural factors could be formed to initialize the analysis of different health data taken from the World Health Organization's data repository. Various health data were taken from the Atlas of Health Statistics 2011 - Health Situation Analysis in the African Region [12] and the Atlas of African Health Statistics 2016 - Health Situation Analysis of the African Region [13]. Both documents were published by the Regional Office for Africa of the World Health Organization. In addition, The Global Health Observatory database [14] managed by the World Health Organization was used as a supplementary source for data collection on the number of hospital beds, medical doctors and pharmacists. Data analysis was done to get an overview of the current state of healthcare systems in various developing countries in the African region.

Selection of Countries

The research question was addressed exclusively to emerging economies that are members of the African Region according to the World Health Organization. Since the African continent hosts a large number of developing countries and, moreover, Africa seems to be the only market that can still offer real growth to the pharmaceutical industry [15], the analysis refers to the developing countries of the African region as defined in the World Health Organization's list of countries [16]. These are only emerging countries defined according to the Development Assistance Committee (DAC) list of the Official Development Assistance (ODA) recipients of the Organisation for Economic Co-operation and Development, effective for reporting on 2011 flows, as countries with a lower-middle income of USD1 006 - 3 975 gross national income (GNI) per capita in 2010 or an upper-middle income of USD3 976 - 12 275 [17]. African countries with a higher income, such as Egypt or Morocco, are not considered in the further analysis. The 47 countries listed in Table 1 are selected for the first data check.

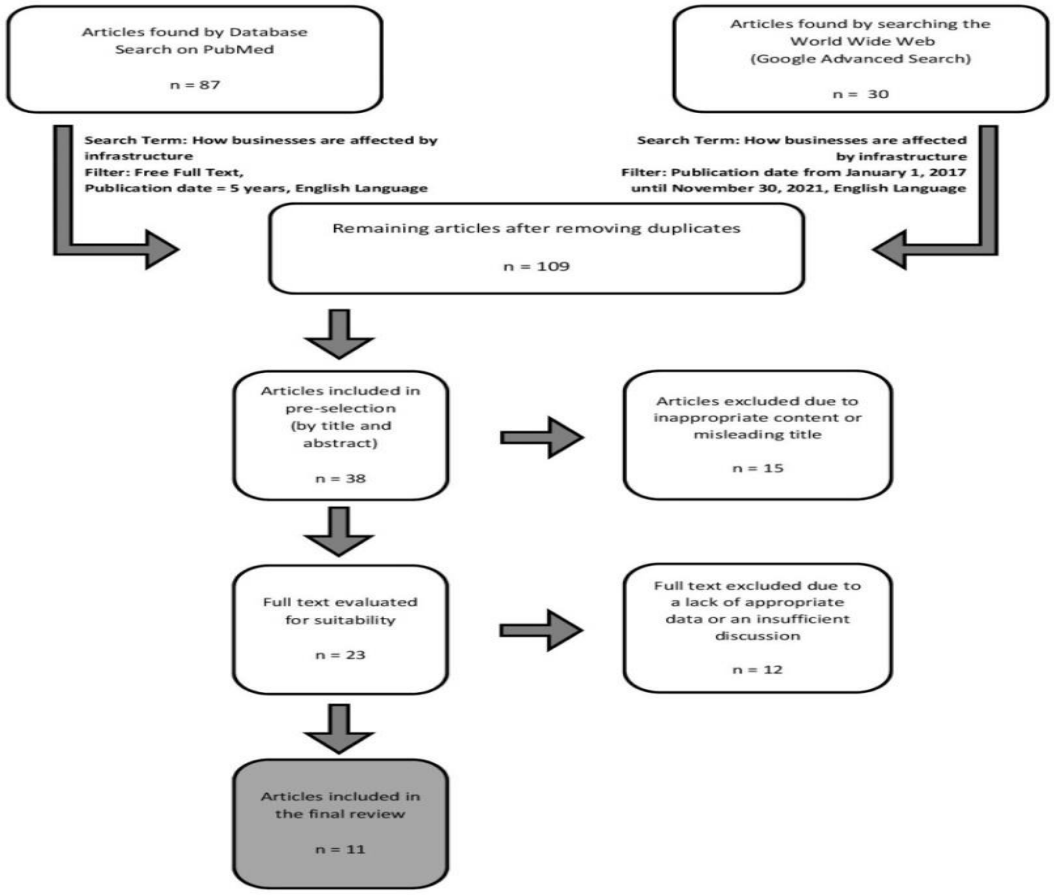

Figure 1: Preferred reporting items for systematic reviews and meta-analysis flow diagram presenting the search strategy

Selection of an appropriate Time Period

In order to provide information about potential trends in past developments over the past two decades in addition to the current state of healthcare systems, datasets of the World Health Organization's data repository from 1995, 2000, 2007, and 2013 were included in the analysis where available.

Selection of studied Infrastructural Factors

The economic and political or governmental infrastructural factors were selected according to the defined factor categories availability of healthcare facilities, access to essential medicines, healthcare financing by government, private healthcare spending and status of infrastructure as shown in Table 2.

Table 1: Countries of the African Region according to the World Health Organization

Algeria	Eswatini	Namibia
Angola	Ethiopia	Niger
Benin	Gabon	Nigeria
Botswana	Gambia	Rwanda
Burkina Faso	Ghana	Sao Tome and Principe
Burundi	Guinea	Senegal
Cabo Verde	Guinea-Bissau	Seychelles
Cameroon	Kenya	Sierra Leone
Central African Republic	Lesotho	South Africa

Chad	Liberia	South Sudan
Comoros	Madagascar	Togo
Congo	Malawi	Uganda
Cote d'Ivoire	Mali	United Republic of Tanzania
Democratic Republic of Congo	Mauritania	Zambia
Equatorial Guinea	Mauritius	Zimbabwe
Eritrea	Mozambique	

Table 2: Selected infrastructural factors according to the defined factor categories

Category	Factor
Availability of healthcare facilities	- Hospital beds - Medical doctors
Access to essential medicines	- Pharmacists
Healthcare financing by government	- Government health expenditure - Government health expenditure per capita
Private healthcare spending	- Out-of-pocket expenditure - Gross national income
Status of infrastructure	- Paved roads - Access to electricity - Internet users - Urban population

The availability of healthcare facilities and access to essential medicines are obviously necessary factors in measuring the development of a healthcare system. The more hospital beds, doctors and pharmacists are available per 10.000 population, the higher the status of the healthcare system in the country and thus its development. In this context, the financial support provided by the state government also allows conclusions to be drawn about the importance of the healthcare system. Here, an increase in per capita spending on healthcare over a certain period of time would indicate a further development of the healthcare system, for example, through the introduction of state health insurances. On the other hand, a decline in private spending on healthcare would underline these developments in the healthcare system. However, private spending must be seen in conjunction with gross domestic product, since an increase in salaries, for example, could also bring a slight increase in healthcare costs. Since a healthcare system cannot be established or developed without an expansion of the infrastructure, infrastructural factors such as the expansion of the road network or access to a stable electricity supply are of interest related to the research question. Overall, all of these factors allow conclusions to be drawn about the current state of development of the healthcare systems in selected emerging countries in the African region and the associated attractiveness for pharmaceutical companies.

Selection of Statistical Methods

The collected data are initially analysed descriptively for each selected factor including mean, standard deviation, minimum, median, and maximum, and the median changes and given in tables. They were also presented graphically for each factor using BoxPlots in the supplement. Nonparametric tests were used because of questionable normal distribution of data. Subsequently, the median change of the factors with two measurement points (hospital beds, physicians, pharmacists, out-of-pocket expenditures) was examined with the Wilcoxon signed-rank test [18-19]. The other factors (Government Health Expenditure, Government Health Expenditure per Capita, Gross National Income, Access to Electricity, Internet Users, Urban Population) are given in more than two time points and were analysed by the Friedman test for repeated measurements

[18-19]. For all tests the significance level is set to alpha=0.05. Because of the explorative Design no adjustment for multiple testing was done. All descriptive analyses and analytical statistical tests are performed using the statistical software R version 3.6.1 as well as SPSS Statistics version 26. It was also used to map the development of the different factors of the healthcare systems within the last two decades (see Supplement).

Results

Analysed Countries of the African Region

Out of the original 47 emerging countries that belong to the African region as member states of the World Health Organization, four countries had to be excluded from the analysis. The data sets on the Central African Republic, Equatorial Guinea, Eswatini and South Sudan were incomplete, so that comparability of all countries within the individual factors could not be ensured. In addition to the countries with incomplete data, the two tourist hotspots Mauritius and Seychelles were also excluded from further analysis, as they have different non-comparable financial capabilities due to booming tourism and achieved by far the highest scores in all factors examined. This would significantly distort the actual results and lead to erroneous conclusions about the development of the healthcare systems and the associated attractiveness for the pharmaceutical industry. Both countries would probably not be as developed without the financial income from tourism, and this would probably also not ensure the comparability of all countries with one another. Thus, only the 41 countries shown in black in Table 3 were included in the final analysis, while the countries with a grey background were not considered.

Availability of Healthcare Facilities

A more detailed review of the mean values of the Availability of Healthcare factors revealed that the number of physicians increased between 2000 and 2007, while the number of hospital beds showed a decrease according to their mean values (Table 4). The statistical tests on the other hand confirm the significant increase in the number of physicians but cannot prove the basically assumed decrease in hospital beds to be statistically significant. This means that the decrease need not have occurred generally in each country. When looking at the individual overview of the total number of hospital beds per 10.000 population and country attached in Supplement, it becomes clear that only some countries actually showed a decrease in hospital beds, while some countries showed constant numbers or even an increase in the number of beds.

Table 3: Finally analysed Countries of the African Region

Algeria	Eswatini	Namibia
Angola	Ethiopia	Niger
Benin	Gabon	Nigeria
Botswana	Gambia	Rwanda
Burkina Faso	Ghana	Sao Tome and Principe
Burundi	Guinea	Senegal
Cabo Verde	Guinea-Bissau	Seychelles
Cameroon	Kenya	Sierra Leone
Central African Republic	Lesotho	South Africa
Chad	Liberia	South Sudan
Comoros	Madagascar	Togo
Congo	Malawi	Uganda
Cote d'Ivoire	Mali	United Republic of Tanzania
Democratic Republic of Congo	Mauritania	Zambia
Equatorial Guinea	Mauritius	Zimbabwe
Eritrea	Mozambique	

Table 4: Statistical analysis of factors on Availability of Healthcare Facilities and Access to Essential Medicines

Infrastructural Factor	Descriptive Parameter	2000-2007	2008-2015	Difference	Wilcoxon P
Hospital Beds (per 10.000 population)	N (Countries)	41	27	27	0.078 (n=27)
	Mean	11.368	11.085	-1.215	
	Standard Deviation	7.7783	7.5837	3.1273	
	Minimum	2.0	1.0	-13.0	
	Median	9.000	8.000	0.000	
	Maximum	32.0	29.0	2.0	
Medical Doctors (per 10.000 population)	N (Countries)	41	41	41	<0.001 (n=41)
	Mean	1.6068	2.1532	0.5463	
	Standard Deviation	2.29396	3.08723	1.22303	
	Minimum	0.13	0.17	-2.11	
	Median	0.7800	1.0200	0.2400	
	Maximum	11.96	18.33	6.37	
Pharmacists (per 10.000 population)	N (Countries)	40	34	34	0.005 (n=34)
	Mean	0.29263	0.60647	0.3163	
	Standard Deviation	0.529849	1.069306	0.71932	
	Minimum	0.004	0.004	-0.24	
	Median	0.0775	0.12000	0.0455	
	Maximum	2.350	4.450	3.14	

Access to Essential Medicines

Both the results of the descriptive and the statistical analysis showed significant increases in the availability of pharmacists (Table 4). This was certainly a significant change for distribution of the pharmaceutical companies' products.

HealthCare Financing by the Government

The results of the descriptive and analytical analyses showed that both the per capita healthcare expenditures of the governments and the general expenditures of the state governments invested in healthcare, showed clear differences between the various measurement points, but no clear linear increase or decrease is evident (Table 5). Thus, one could speak of an increase between 1990/1995 and 2007/2008 with a subsequent decrease until 2013. This significant decrease between the two measurement dates 2007/2008 and 2013 is also confirmed by the supplementary Wilcoxon signed-rank tests carried out for these factors (Supplement). Accordingly, this could mean that state governments initially invested more financial resources in the further development of healthcare systems and that lower financial resources are now sufficient to maintain current healthcare provision. At this point, it would have to be investigated whether the lack of funds is compensated by international health programs or development funds, for example.

Private Healthcare Spending

While the analytical tests clearly show that Gross National Income increased significantly over the period (Table 5), private health spending has demonstrably declined (Table 6). This suggests that people could build up more financial reserves and that governments could make healthcare more affordable for people through more international funding.

Table 5: Statistical analysis of factors on Government's Healthcare Financing and Private Healthcare Spending

Infrastructural Factor	Descriptive Parameter	1990/1995	2000	2007/2008	2013	Friedman P
Government Health Expenditure (in %)	N (Countries)	33	41	41	40	0.004 (n=33)
	Mean	8.294	8.556	10.327	10.857	
	Standard Deviation	2.5605	3.3821	3.8243	4.3416	
	Minimum	3.0	0.4	4.0	3.6	
	Median	8.200	8.800	10.700	10.300	
	Maximum	14.2	17.9	19.5	24.3	
Government Health Expenditure per Capita (in $)	N (Countries)	39	40	41	40	<0.001 (n=38)
	Mean	43.44	85.30	135.37	120.53	
	Standard Deviation	53.277	124.002	192.419	154.383	
	Minimum	1	8	17	14	
	Median	22.00	47.50	71.00	49.50	
	Maximum	189	551	819	577	
Gross National Income (in $)	N (Countries)	36	38	39	41	<0.001 (n=34)
	Mean	1432.22	1701.84	2466.15	3587.80	
	Standard Deviation	1892.984	2189.445	3149.927	4111.009	
	Minimum	270	300	290	680	
	Median	740.00	910.00	1230.00	1750.00	
	Maximum	9700	9960	13100	17220	

Status of Infrastructure:

Considering the mean values of the infrastructural factors and the corresponding median changes according to the analytical tests reflect a significant improvement in stable electricity supply and Internet use (Table 7). Even though in 2013, only an average of 35.6% of the population had access to a stable electricity supply, and of these, just an average of 9.8% use the Internet.

On the other hand, the low figures for the expansion of the paved road network suggest less developed medical care in the remote villages that are difficult to access. Figure 2 shows that in 2007, only 4 of the 41 countries in the African region had more than 50% of their roads paved. In

37 countries, not even 30% of the existing roads have a solid road surface. Even South Africa, as the African country with the highest adaptation to Western habits, has only 17% paved roads of all existing roads. Nigeria, with a share of 15%, also belongs to this group.

Table 6: Statistical analysis of factors on Private Healthcare Spending

Infrastructural Factor	Descriptive Parameter	1995	2013	Difference	Wilcoxon P
Out-of-pocket Expenditures (in %)	N (Countries)	33	40	33	0.004 (n=33)
	Mean	43.03	35.63	-6.8788	
	Standard Deviation	18.769	17.800	11.51563	
	Minimum	6	5	-31.00	
	Median	46.00	35.50	-7.0000	
	Maximum	73	73	14.00	

This assumption is supported by the significant demonstrable increase in urbanization. Overall, it can be concluded that the healthcare systems have certainly developed further over the past two decades. Significant changes could be identified by means of the statistical analyses, even if these changes are not yet large enough in most countries in consideration of the individual analyses in Supplement, there are still large differences between the countries.

Table 7: Statistical analysis of factors on Infrastructure

Infrastructural Factor	Descriptive Parameter	1990/1995	2000	2007/2008	2013	Friedman P
Access to Electricity (% of population)	N (Countries)	n.a.	32	39	40	<0.001 (n=31)
	Mean	n.a.	23.772	31.141	37.773	
	Standard Deviation	n.a.	19.7181	21.4698	22.8846	
	Minimum	n.a.	2.7	1.2	6.9	
	Median	n.a.	16.100	30.000	36.450	
	Maximum	n.a.	73.6	82.7	86.4	
Internet Users (in %)	N (Countries)	n.a.	41	41	41	<0.001 (n=41)
	Mean	n.a.	0.593	3.4712	13.034	
	Standard Deviation	n.a.	1.1540	3.40074	12.1310	
	Minimum	n.a.	0.0	0.22	1.0	
	Median	n.a.	0.200	2.2600	9.800	
	Maximum	n.a.	5.3	14.59	49.0	

Urban Population (in %)	N (Countries)	41	41	41	41	<0.001 (n=41)
	Mean	30.37	35.24	39.05	41.10	
	Standard Deviation	14.268	16.126	17.448	17.203	
	Minimum	5	8	10	12	
	Median	29.00	34.00	37.00	40.00	
	Maximum	69	80	85	87	

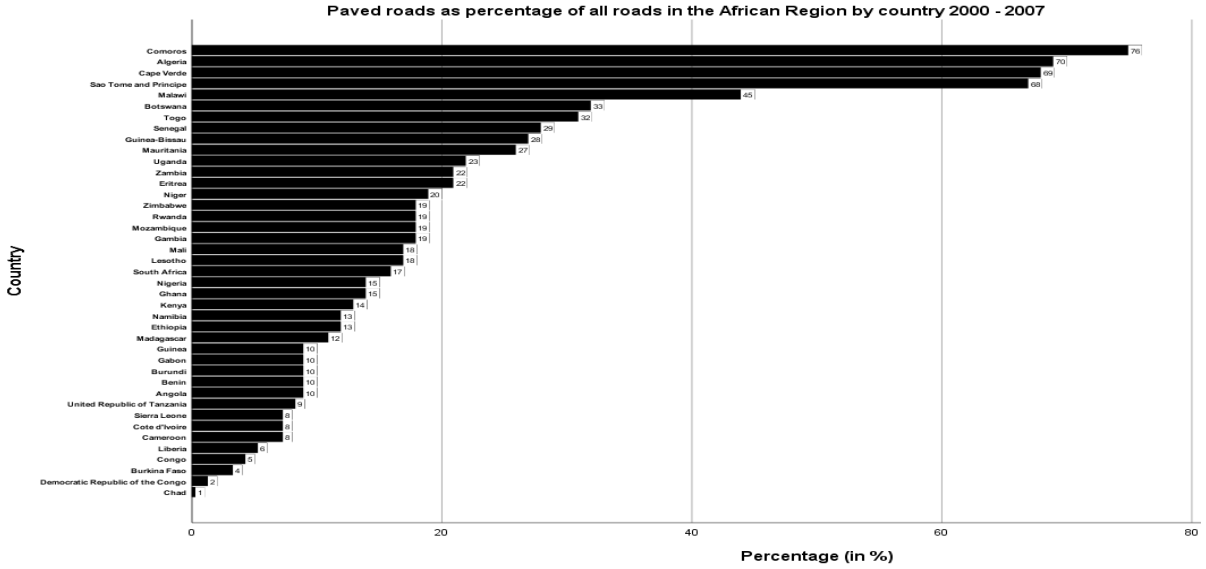

Figure 2: Paved Roads as percentage of all roads as average of the time period 2000-2007

Discussion

Considering the results presented, it is evident that the health systems of emerging countries in the African region have evolved and improved overall over the past two decades. According to Kollewe, the Access to Medicine Foundation report also speaks of "massive improvements in global health in the past decades" [20]. In the past ten years alone, the number of people without access to adequate healthcare has been reduced by 10% [21]. The United for Africa group of aid and development organizations believes that this is due in part to the Millennium Development Goals and the Sustainable Development Goals introduced in 2016 [21]. Nonetheless, there are still wide disparities between countries, which means that adequate healthcare is not a natural part of life in many African countries [21]. According to a study by the African research institute afrobarometer, around 50% of people in many African countries still have consequently no or inadequate access to healthcare [21].

Reasons for these disparities are seen in various areas. United for Africa, for example, takes a very critical view of the role of governments, since many African countries do not yet have sufficient laws to equalize the large differences between rural regions and urban centres and to stop the corruption of medical personnel politically [21]. The Access to Medicine Foundation, however, sees lack of research by the pharmaceutical industry as a significant reason [20]. It's report states that "91 of 138 urgently needed drugs, vaccines, diagnostic tests or devices identified by the World Health Organization have yet to be developed, and 16 prioritised diseases have no projects at all" [20]. To make medicines available to people in developing countries, drug firms need to do more [20]. However, improving healthcare in these countries cannot be addressed by one area alone, but rather by an interaction of both areas, which must ultimately lead to stabilization of healthcare in African countries with assurance of access to needed medicines. Close collaboration of pharmaceutical industry with national governments and other partners should thus be sought [20].

The economic and political or governmental infrastructural factors examined in this paper are also presented, according to the business and strategy consulting firm McKinsey & Company, as potential difficulties that hinder the pharmaceutical industry from successfully collaborating to improve healthcare in African countries. The lack of road infrastructure represents a good example in this context, as it makes it impossible to transport medical products to rural areas in many countries and denies the population access to medical products [22]. In addition, the electricity supply in these areas is often unstable, so that Internet use is not possible and technologically modern medical care services, such as telemedicine and online consultations in particular, cannot be used. This largely poor information and communication technology infrastructure thus hinders widespread medical care and makes it difficult for the pharmaceutical industry to distribute its medical products nationwide. This also limits the sales market and the supply of drugs, vaccines, blood products and medical devices. It is therefore not surprising that in most countries the population is increasingly moving to the cities and these are becoming population centres with better logistical infrastructure and medical care as well as higher purchasing capacity and access to modern medicine [22]. There (i.e. in the cities), the proportion of the population that has access to the services of the healthcare system is increasing, and it is becoming more and more obvious that not only communicable diseases such as tuberculosis, HIV or malaria are major challenges for African countries, but also that the so-called non-communicable diseases such as heart attack, diabetes or stroke are increasingly present in countries such as Nigeria or South Africa [22]. This offers the pharmaceutical industry the opportunity to focus on population centres and market their products there, which are already effective in the area of non-communicable diseases [22, 23]. In addition, the development of new marketing channels is also beneficial, such as by forming new partnerships with local partners who can establish new supply chains or telemedicine portals to reach populations in more remote rural areas [15, 23]. In addition to infrastructure development, it would also be important to improve health system services. The focus here is, of course, on creating more hospital beds and recruiting qualified medical staff. Data on the availability of healthcare facilities and access to essential medicines confirm the lack of well-trained professionals and medical care centres mentioned by Ascher *et al*. [22] even though there has been a fundamental increase in the last two decades. Thus, in some countries, such as Nigeria, it is not uncommon to find a kind of medical tourism to India or South Africa [23]. South Africa, as country with Western structures, has a relatively solidly developed healthcare system with a correspondingly attractive drug sales market [10]. Therefore, medical tourists over there often also receive better medical care at relatively lower costs than in their home country.

The governments of most countries invest only a small part of their total budget in healthcare, which often covers only basic care [22]. Over the last two decades, this proportion has increased in most countries, in line with the per capita spending of governments on healthcare, but the population still has to pay a certain proportion of healthcare costs out of their own pockets. In some countries, private health insurance is available to cover a certain portion of healthcare costs, but only a small percentage of the population can afford the required insurance premiums. For example in Nigeria, according to Holt *et al* [23], 70% of healthcare expenses still have to be paid privately, and only about 5% of households are financially able to cover these expenses. Thus, it is reasonable that a large proportion of the population first visits pharmacists - and especially unlicensed ones with limited experience and less effective devices - before consulting trained physicians for medical problems [23]. In addition, counterfeit drugs and parallel imports compete with licensed original drugs [23]. These medicines are often sold in retail kiosks or informal outlets [24]. For example, according to Conway et al. [10], the import rate of over-the-counter and prescription drugs in sub-Saharan Africa is between 70% and 90%.

In order to boost the performance of the pharmaceutical industry including their clinical research activities, close cooperation with the governments of developing countries is inevitable, e.g., innovative prices for medical products can be offered that are adjusted to the countries' gross domestic product in order to provide the population with access to low-cost but high-quality drugs

from a financial perspective. This means that the pharmaceutical industry must adapt to the financial resources of consumers and deviate from its "policy to maintain high drug prices and hold on to exclusive rights for their production" [25]. Further improvement of the business model would probably also be beneficial for the conquest of national sales markets in African countries. Governments would need to take more and more control over the prices of medical products, legislate on wholesale and retail profit margins, and impose import restrictions to encourage limited national production of medical products [23]. Using Nigeria as an example, efforts should be focused on the large patient groups in urban areas, which are primarily middle class and more likely to afford original drugs [26]. At the same time, efforts should be made to market a second, cheaper product to a wider population mass in order to reach as many segments of the population as possible [26]. Collaboration between the pharmaceutical industry and state governments would also allow for continuous improvement in regulatory quality standards so that counterfeit, expired, or non-standard drugs could gradually be further eliminated from national outlets [10]. This would not only save countless patient lives, but also allow for fair trade [10]. According to Holt et al. [15], annual growth of about 6% in prescription and over-the-counter medicines, 9% in generics, and as much as 11% in medical devices has already been observed in recent years. Furthermore, it would be advisable for the economic existence of the pharmaceutical industry in developing countries if companies start to think beyond their original business models, for example, by developing medical products specifically for local conditions, such as much more heat-resistant products [26]. Overall, therefore, it would make sense for the pharmaceutical industry to build strong local teams that are familiar with local conditions and can work closely with the state government [15]. Regardless of all the factors discussed, however, the pharmaceutical industry must be willing to actually implement its slogans about care for global health and finally become part of the solution instead of remaining part of the problem [25]. In this context, a uniform sales market with standardized framework conditions for the approval and marketing of medical devices would be a beneficial impulse, for example, to enable the pharmaceutical industry to obtain a central drug approval that is valid for several countries in parallel. Currently, a drug approval is only recognized nationally without automatically authorizing marketing in neighbouring countries [10]. Consequently, the bureaucratic burden is much higher in developing African countries. This standardization and harmonization of regulatory requirements would enable cross-national cooperation, allowing smaller countries to advance their development and improve medical device supply chains [10]. On the one hand, this would ultimately translate into health systems development with improved medical care for the population. On the other hand, the pharmaceutical industry would no longer use these countries as testing grounds for their products to be marketed mainly in Western markets, but would have sufficient incentives to also use national markets for marketing.

Limitations

The following limitations to the research question were identified. Firstly, only published data from the World Health Organization were used, as both the 2011 and 2016 Atlas of Health Statistics examined the same parameters due to their broadly identical structure. This ensured proper comparability of the data and provided a comprehensive view of the development of health systems over the past two decades. Secondly, the World Health Organization's The Global Health Observatory database used in this review lacked consistent annual data on different countries, which made it necessary to create time periods in order to present the trends in some parameters. These contained data from different years that were representative of that time period.

Conclusions

Implications for practice

By means of the economic and political or governmental infrastructural factors examined, it was possible to map the current state of development of the healthcare systems of various African developing countries. It is evident that, although all countries have undergone further development in the context of globalization, there are still differences in economic development between the individual countries.

These differently developed healthcare systems in African countries also offer a sales market with growth potential in the future. This offers the pharmaceutical industry a promising opportunity to successfully market its products, as the sales markets in the developed countries are mostly stagnating [15]. However, in order to benefit from this growth potential, the pharmaceutical industry must understand the aforementioned infrastructural challenges first and actively participate in overcoming them, i. e. by adaptation to the financial resources of the consumers [15]. Indeed, even though an infrastructurally fully developed healthcare system would be desirable for the pharmaceutical industry to be able to market its products profitably without effort, its active participation in the development of healthcare systems, by being a cooperation partner of national governments, is imperative to achieve comprehensive medical care for the country's population. Compared to the healthcare systems of fully developed countries, those of developing countries are far less developed, so that a pure presence of the pharmaceutical industry with its general business models would not be promising here in order to survive on the national sales markets [26]. Adaptation to the different local conditions is therefore inevitable. For this purpose, the commercial business model should be reconsidered and adapted to the country-specific challenges and the portfolio should be aligned, taking into account possible marketing channels and prices of the respective country [22, 26]. It can thus be concluded that an expansion of the analyzed economic and political or governmental infrastructural factors would definitely have an impact on the pharmaceutical industry's performance.

The pharmaceutical industry should therefore cooperate even more closely with the national governments of the African developing countries and provide further funding for clinical research and market more products on the national sales markets so that the drug portfolio and treatment options for various diseases as well as the medical care of the national population can be expanded. The joint goal of governments and the pharmaceutical industry must be the strengthening of infrastructural factors with the distribution of affordable medicines to all sections of the population. This is the only way to permanently improve healthcare in these countries and expand it nationwide.

Implication for research

The gaps in the Global Health Observatory database used in this review, especially the lack of consistent annual data on different countries, should be addressed by ensuring that data are collected at necessary time periods in order to fully capture the trends in some parameters. This will ensure that there are no missing information required to enable comparison of yearly datasets, and that data from different years are representative of that time period.

REFERENCES

1. Development Bank of Southern Africa. How businesses are affected by a country's infrastructure. 2021. https://www.dbsa.org/article/how-businesses-are-affected-countrys-infrastructure. Accessed 11 Dec 2021.
2. Wu Q, Guan X, Zhang J, Xu Y. The Role of Rural Infrastructure in Reducing Production Costs and Promoting Resource-Conserving Agriculture. International Journal of Environmental Research and Public Health 2019; 16: 3493.
3. Eum NJ, Kim SH. A Cross-Country Comparative Study on the Role of Information and Communication Technology Policy and Infrastructure to Curb the Spread of Novel Coronavirus. JMIR Public Health and Surveillance 2021; Epub ahead of print.
4. Kruse C, Betancourt J, Ortiz S, Valdes Luna SM, Bamrah IK, Segovia N. Barriers to the Use of Mobile Health in Improving Health Outcomes in Developing Countries: Systematic Review. Journal of Medical Internet Research 2019; 21, 10: e13263.
5. Olanrewaju CC, Chitakira M, Olanrewaju OA, Louw E. Impacts of flood disasters in Nigeria: A critical evaluation of health implications and management. Jamba – Journal of Disaster Risk Studies 2019; 11, 1: 557.
6. Eze E, Gleasure R, Heavin C. Mobile health solutions in developing countries: a stakeholder perspective. Health Systems 2020; 9, 3: 179-201.

7. Kironji AG, Hodkinson P, Stewart de Ramirez S, Anest T, Wallis L, Razzak J, Jenson A, Hansoti B. Identifying barriers for out of hospital emergency care in low and low-middle income countries: a systematic review. BMC Health Services Research 2018; 18: 291.
8. Falchetta G, Hammad AT, Shayegh S. Planning universal accessibility to public
9. healthcare in sub-Saharan Africa. PNAS - Proceedings of the National Academy of Sciences of the United States of America 2020; 117, 50: 31760-31769.
10. Ekeigwe AA. Drug manufacturing and access to medicines: the West African story. A
11. literature review of challenges and proposed remediation. AAPS Open 2019; 5:3.
12. Conway M, Holt T, Sabow A, Yuan Sun I. Should sub-Saharan Africa make its own drugs? McKinsey & Company. 2019. https://www.mckinsey.com/industries/public-and-social-sector/our-insights/should-sub-saharan-africa-make-its-own-drugs. Accessed 25 Jan 2021.
13. Ziegler A, Antes G, König IR. Preferred report items for systematic reviews and meta-analyses: the PRISMA statement [in German]. Deutsche Medizinische Wochenschrift 2011; 136: e9-e15.
14. African Health Observatory. World Health Organization – Regional Office for Africa. Health Situation Analysis in the African Region – Atlas of Health Statistics 2011. 2011. http://www.aho.afro.who.int/en/atlas/atlas-african-health-statistics-2011. Accessed 30 Jan 2021.
15. African Health Observatory. World Health Organization – Regional Office for Africa. Atlas of African Health Statistics 2016 – Health situation analysis of the African Region. 2016. http://www.aho.afro.who.int/en/atlas/atlas-african-health-statistics-2016-health-situation-analysis-of-the-african-region. Accessed 30 Jan 2021.
16. World Health Organization. The Global Health Observatory – World Health Data Platform. 2021. https://www.who.int/data/gho/data/indicators/indicator-details/GHO. Accessed 06 Feb 2021.
17. Holt T, Lahrichi M, Santos da Silva J. Africa: A continent of opportunity for pharma and patients. McKinsey & Company. 2015. https://www.mckinsey.com/industries/pharmaceuticals-and-medical-products/our-insights/africa-a-continent-of-opportunity-for-pharma-and-patients. Accessed 20 Jan 2021.
18. World Health Organization – Regional Office for Africa. WHO African Region Country Offices. 2017. https://www.afro.who.int/countries. Accessed 28 Jan 2021.
19. Aimée N: OECD. DAC List of ODA Recipients – Effective for reporting on 2018, 2019 and 2020 flows.
20. https://www.oecd.org/dac/financing-sustainable-development/development-finance-standards/DAC_List_ODA_Recipients2018to2020_flows_En.pdf. Accessed 01 Apr 2021.
21. Salcedo J, McCormick K. SPSS Statistics For Dummies (4th Edition), John Wiley & Sons Inc. 2020. ISBN 978-1-119-56083-8.
22. Bland M. An Introduction to Medical Statistics (4th Edition). Oxford University Press 2000. ISBN 978-0-19-958992-0.
23. [Kollewe J. Big pharma 'failing to develop urgent drugs for poorest countries'. The Guardian. 2018. https://www.theguardian.com/business/2018/nov/20/big-pharma-who-failing-to-develop-urgent-drugs-for-poorest-countries. Accessed 25 May 2021.
24. Gemeinsam für Afrika e.V.. Healthcare in African Countries 2016 [in German]. 2016. https://www.gemeinsam-fuer-afrika.de/gesundheitsversorgung-in-den-laendern-afrikas/. Accessed 12 Jun 2021.
25. Ascher J, Bogdan B, Dreszer J, Zhou G. Pharma's next challenge. McKinsey & Company. 2015. https://www.mckinsey.com/industries/pharmaceuticals-and-medical-products/our-insights/pharmas-next-challenge. Accessed 02 Feb 2021.
26. Holt T, Millroy L, Mmopi M. Winning in Nigeria: Pharma's next frontier. McKinsey & Company. 2017. https://www.mckinsey.com/industries/pharmaceuticals-and-medical-products/our-insights/winning-in-nigeria-pharmas-next-frontier. Accessed 31 Jan 2021.
27. Quick J, Boohene NA, Rankin J, Mbwasi RJ. Medicines supply in Africa – Should improve through regional collaborations and accredited drug shops. BMJ 2005; 331: 709-710.
28. den Boer M, Morgan R. Bad Pharma, Bad Karma: The Pharmaceutical Industry in Developing Countries. EU-topias. 2015. http://eu-topias.org/en/bad-pharma-bad-karma-the-pharmaceutical-industry-in-developing-countries/. Accessed 07 Jul 2021.
29. Agarwal A, Dreszer J, Mina J. What's next for pharma in emerging markets? McKinsey & Company. 2017. https://www.mckinsey.com/industries/pharmaceuticals-and-medical-products/our-insights/whats-next-for-pharma-in-emerging-markets. Accessed 31 Jan 2021.

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