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Dedication

It is our pleasure and great privilege to present the fifty-sixth issue of the Academic Journal of Research and Scientific Publishing to all researchers and doctors who published their research in the issue, and we thanks and appreciate to all contributors and supporters of the academic journal and those involved in the production of this scientific knowledge edifice.

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Measuring the impact of tax revenues on economic growth and investment in Sudan during the period (2006-2021)

Dr. Ebtihag Hashim Mohammed Ealgzoli

Assistant Professor, PhD in Economics, College of Business Administration, Albaha University, Kingdom of Saudi Arabia Email: bojeboje@hotmail.com

Abstract

This study aimed to identify the nature of the relationship between tax revenues economic growth and investment in Sudan during the period (2006-2021). Also building mathematical models through which tax revenues can be predicted. The descriptive analytical approach was used. The study relied on secondary data collected from the reports of the Central Bank of Sudan for different years. The study used the Autoregressive Distrbuted Lag Mode methodology (ARDL) to analyze tax revenue data to find out the nature of the relationship between the study variables for the long and short period of time for the Sudanese economist. The standard approach was also relied upon to estimate the relationship and nature between tax revenues, economic growth and investment in Sudan. The research showed the validity of some of the hypotheses of the study. The existence of a positive relationship between tax revenues and economic growth and the invalidity of the hypothesis for the existence of a positive relationship between tax revenues and investment, the study reached a number of results, the most important of which is that there is a positive relationship between tax revenues and economic growth and the inverse relationship between tax revenues and investment, due to the weak ability of Sudan to compete in Attracting foreign investments, The main reason for this is due to the weak investment climate in the country, and the weakness of attractive regulations, laws and policies, The most important recommendation of the study is the need to work to improve the tax base and reduce tax evasion because taxes have a positive impact on GDP.

Keywords: Tax revenues, Economic growth, Investment, Sudan



1. Introduction:

Revenues and expenditures are considered among the main elements that reflect the strength or weakness of the economy and therefore reflect the actual picture of the economy through the difference between them. Where a deficit or surplus appears for the country budget, as well as the economic performance of the national accounts of various countries. As general revenues develop in volume and type, general expenditures increase and diversify. Revenues are considered an important performance among the financial policy tools, and through them governments can influence economic activity. The concept of general revenues includes achieving economic and social goals by collecting the incomes that the country obtains through its various economic or non-economic units. The governments depend on various sources of general revenues, and the importance of these sources varies according to the prevailing economic and political system in the country and the extent of its progress. Among its components are taxes, which are considered the most important sources in the modern era because of their impact on the economic, political and social aspects through which governments can influence the market, redistribute income and distribute resources. They are considered a source of government revenue to finance expenditures, which are known as tax revenues. Its importance has increased with the development of general career sector, and the country needs economic resources through which it can satisfy its tax needs. The tax is considered a contribution from members of society and bears general burdens as a contribution towards the country. The most important sources of tax revenues in Sudan are income tax, business profits, and capital gains, value added tax (VAT) and taxes on international trade and production.

1.1. The problem of the study: Despite the increase in tax revenues as a result of the expansion of the tax umbrella, Sudan still suffers from widespread evasion and the non exist of several commercial activities from the collection department.

The problem of the study emerges from the following questions:

What is the nature of the relationship between tax revenues and economic growth?

1.2. The importance of the study: The importance of the study lies in the fact that tax revenues have a vital role in addressing the financial imbalance, achieving growth and economic stability, and creating accurate predictions of tax revenues. The practical importance of this study comes to reach the best standard model for measuring the relationship between the study variables through the latest application Methodologies for measuring relationships in both the short term and the



long term, which is represented by the (ARDL) methodology, for the purpose of benefiting from this relationship in serving economic decision-makers in developing the appropriate economic policy for how to collect taxes and benefit from them.

1.3. Objectives of the study: The study aims to:

- 1. Determine the nature of the relationship between tax revenues, economic growth, and investment in Sudan during the period (2006-2021).
- Identify the general trend in prediction tax revenues in Sudan during the period ((2006-2021) AD)
- 3. Identify the growth of tax revenues in Sudan during the period (2006-2021).
- **1.4. Study hypotheses:** The study contains a number of hypotheses:
- 1- There is a long-term complementary relationship between tax revenues and total local product.
- 2- There is a long-term complementary relationship between tax revenues and investment.
- 3- There is a correlation statistically significant relationship between tax revenues and economic growth in the long and short term.
- 4- There is a correlation statistically significant relationship between tax revenues and investment in the long term and the short term.

1.5. Study Methodology: The study depends on the descriptive analytical approach, where the descriptive aspect is used in graphs and descriptive statistics of tax revenues in Sudan, while the standard aspect is used in building mathematical models to analyze the results to prove the study's hypothesis and the accuracy of its predictions. Through the use of an autoregressive with time gaps distributed known as the ARDL model.

1.5.1. Data sources: The study depended on secondary data obtained from reports for different years at the Central Bank of Sudan in Sudan during the period (2006-2021).

1.5.2. Study limitations:

Time limitations (2006 – 2021) AD

Place limitations (Sudan)

2. Previous studies:

Hazem Sakban Hassan - Manahil Mustafa Abdel Hamid 2023P: This study aimed to identify the tax system and its efficiency in the Iraqi economy during the period from (2004-2020). The study relied on the extrapolate analysis method by analyzing the data, tracking its developments

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over time, extrapolating the economic reality, and then extrapolate the effects and results to reach to the specific results through the available economic tools. . The study concluded that the tax system in Iraq is characterized by its weak flexibility and its inability to respond to the requirements of economic growth or to the changes occurring in the structure of economic activity, and thus the reduced role of tax revenues in financing the general budget in Iraq as a result of the low contribution rate, as it constituted an average contribution rate of (11.1%) of total general revenues, and this confirms the rentier of the Iraqi economy and its heavy dependence on oil revenues to finance the general budget. Finally, indicators of the efficiency of the tax system in Iraq indicated a low level of efficiency of that system, as the tax system was unable to exploit tax capacity efficiently, and this led to the loss of tax revenues that would have provided tax revenues that would feed government expenditures. Tax rates also need the necessity adopting the replacement of some of the applied taxes with taxes that is more effective, contributes to increasing tax revenues and feeding better general budget. While the research recommended the need to increase the efficiency of the taxpayer inventory system because it is the first step to identify all sources of income subject to tax. The accuracy of the inventory expresses the extent of the management's success as well as activating the role of tax oversight in implementing the tax law and reducing opportunities for tax evasion through the formation of inspection committees from some independent bodies and academics are prepared to impart independence and efficiency upon inspection.

Shiad Faisal study 2022: This study aimed to identify the impact of taxes on economic growth in Arab countries during 2010 - 2018. The study conducted several preliminary tests, including descriptive statistics, stability tests from the first and second generation, and cointegration. The group mean and combined group test were used and models were better determined using the Hausman test. The results indicated that taxes are negatively related to economic growth in the study sample. Therefore, weak tax levels are more conducive to economic growth as supported by the economic impact of Ibn Khaldun's theory on taxes, which endorses the positive impact of a lower tax rate on work, output and economic performance. Using the generalized moments method estimation, it was found that there is an inverse effect of non-correlation taxes on gross capital formation.

Study by Houari Sufyan and Nagal Fatima 2021: This study aimed to determine the effectiveness of tax policy as one of the financial policy tools in achieving economic growth



during the period, 1990-2019, based on the least squares method OLS. It was found that there is a correlation and positive relationship through the impact of tax policy on economic growth through petroleum levy in the short and long term as Algeria's economy is rentier. It was also concluded that growth was not affected by regular collection despite the amendments made to it in 1992, but it remains insufficient and requires other reforms.

Study by Muhammad Amin Qabour - Misbah Harrak 2020: This study aimed to measure the impact of regular collection revenues on the general budget in Algeria during the period (1991-2018), through the position of regular collection revenues in the general budget revenues as well as its ability to finance general expenditures. The analytical approach was used following the joint integration approach within the framework of the ARDL model., to use the Eviews program. The results of the study found that there is a co-integration between regular collection revenues (Impd, Ddn, Tva, Tmb) and the general budget, and there is a positive impact of regular collection revenues on the general budget in Algeria. This indicates that the higher the revenues (Impd, Ddn, Tva, Tmb) will lead to an increase in the general budget.

Study by Sanaa Nazmi - Khaled Mafah Muhammad 2015: This study aimed to identify the role of tax revenues in supplementing the Jordanian general budget with general revenues by conducting a comparative analytical study during the period between 2006-2013, which focused on comparing the role of income tax, sales tax, and other taxes in increasing the scale of general revenues in the general budget. In Jordan, the study used the analytical approach and to achieve the objectives of the study, the study was divided into two financial periods, the first period before the implementation of the amended income and sales tax law for the period between 2006-2009 and the one second after the implementation for the period between 2010-2013. The study concluded with the following most important results: Tax revenues contributed more than non-tax revenues, grants and foreign aid, in supplementing the general budget, in general revenues, as the percentage of tax revenues out of general revenues constituted approximately 64%. The sales tax played the largest role in supplementing the general budget with tax revenues, compared to the income tax and other taxes, as the sales tax, income tax, and other taxes each contributed, on average, approximately (64%, 25%, and 11%) of the tax revenues, respectively. One of the most prominent recommendations of the study was to make amendments to the income tax law and the sales tax law based on a thoughtful basis to increase tax revenues that contribute to supplementing the general budget with general revenues.



3. Theoretical framework:

General revenues:

General revenues are the important substrate upon which financing general expenditures is used, through which the country carries out all its financial activity and achieves its goals. (Flih Hassan Khalaf, 2008, p. 161)

One of the concepts that preoccupied many general finance thinkers is that general revenues have become increasingly important for two reasons:

- Collecting money is not the main purpose of revenues, but rather influencing general life to achieve economic and social goals.
- The scale of expenditures inflation as a result of the increase in the country's careers, so it was necessary to increase the scale of revenues in order to have a broader impact on general revenues. The increase and diversification of general revenues in a way that enables the structure of general revenues include:
- Revenues that the government receives from taxes.
- Revenues from general projects (General sector).
- Revenues from internal and external loans.
- Deficit financing through new monetary issuance.
- Other revenues.

These types included in the general revenue structure differ according to their importance and the nature of the revenues in terms of the system and the degree of their development.. (Flih Hassan Khalaf, 2008, p. 164).

Tax revenues:

As a result of the country's intervention in economic activity and to increase national income, taxes were considered one of the main sources of financing that countries depend on to finance general expenditures. Therefore, taxes have a contemporary definition of the concept of tax, which is that it is a monetary payment imposed by the country on individuals and companies with the intention of covering general expenses. It is an obligation monetary borne by those assigned by the country to achieve its goals (Khaled Amin and others, 2015, p. 12) The tax is considered a monetary obligation and a compulsory duty, imposed by a country without charge. The tax aims to achieve general benefits (Mohammed Khasawneh, 2014, p. 90) The tax is not only used for a financial purpose, but it also achieves social goals, such as reducing disparities between classes.

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Its economic goal is to limit consumption, investment guidanceand encourage saving, and thus affect the national economy. (Abdul Karim Sadiq Barakat, 1983, p. 13). Therefore, the objectives of tax vary between economic, financial and social objectives. It becomes clear that the tax system in any country seeks to achieve these various tax objectives. The priorities of these objectives are political and social preference, and the means of tax policy tools that are applied differ with each economic system and the degree of development, whether it is economic or social (Khadija Al-Aasar, 2016, p. 141).

Tax revenues in Sudan: The budget structure in Sudan, which was issued by the International Monetary Fund in 2001, consists of general revenues, expenditures, surplus, total deficit, and sources of financing. General revenues include direct and indirect taxes, grants, and the most important sources of tax revenues are income, business profits, capital profits, value-added tax, taxes on international trade and production and some other taxes. Non-tax revenues consist of sales of goods and services, property rights income, and customs duties. (Bank of Sudan Report 2021, p. 123).

Taxes on income, profits and capital profits: It is deducting a portion of the income obtained from different incomes and dividing it according to the entity to which it is deceived. (Ministry of Finance, 2017, p. 21) The income is divided into several types (work - capital - industrial projects - income from professions), Thus, there is a difference in processing in the tax due to the multiple taxes, which leads to a difference in the estimation of the tax base and collection methods.

- **Property taxes** are a wealth tax, provided that they can be changeable. Wealth is considered as a balance, not a current. It is divided into real and inheritance taxes and they are considered as an important taxes.
- Taxes on goods and services have multiple forms, including customs and sales taxes, which are considered important for the country, especially in developing countries (Mohammed Khasawneh, 2014, pp. 98-110).
- Taxes on international trade and transactions are the taxes imposed on goods that cross borders, including customs, exports, imports, and exchange profits (Ministry of Finance 2017, p. 22). Revenue taxes and customs duties are imposed on imported goods when they enter the country and constitute a high percentage of government revenues due to the increase in imports goods (Mahmoud Hussein Al-Wadi, 2015, p. 77).



Tax revenue growth	Taxes	Year
	5.881	2006
9.938744	6,530	2007
9.49773	7,680,3	2008
11.2699	8,655.8	2009
13.51638	10,008.6	2010
14.50406	11,183,3	2011
28.16206	15,567.4	2012
30.49518	24,133.7	2013
35.39567	35,178.1	2014
36.16937	41,963.3	2015
41.20194	47257	2016
45.98631	63849	2017
50.10126	91,345	2018
69.91496	114,060	2019
70.68977	159,949	2020
74.98581	639,433	2021

Table No. (1) Shows revenue growth during (2006-2021)

Source prepared by the researcher from the main table of the study

Table No. (1) shows the tax revenues growth in Sudan during the study period. This is mainly due to the increase in correlation taxes (income taxes and property taxes) as a result of an expansion of the tax umbrella by reducing tax exemptions and adjusting some categories on goods and services, in addition To continue implementing and expanding the electronic collection project, despite widespread evasion and the departure of several commercial activities from the collection department, in addition to continue to organize campaigns to combat customs tax evasion (Bank of Sudan Report, 2020, p. 109).





Figure (1) shows the growth of tax revenues during the study period

Figure (1) shows the growth of tax revenues during the study period

Tax challenges in Sudan (tax evasion):

Tax evasion means non-payment of the tax, in whole or in part, by the person responsible for paying it. As a result, the country does not receive revenues, as transferring its burden does not cause the country to lose the tax revenue. Tax evasion can be achieved by the following: -

- Not practicing the activity on which tax is imposed.
- Carrying out the activity in various illegal ways, such as financial fraud or deception, and in the case of customs tax, introducing goods illegally, and for income and wealth tax, concealing some elements of income, all these affects tax collection.
- The causes of tax evasion are many and varied, the most important of which are poor accuracy and clarity in the tax system, multiple taxes, weak tax awareness, and a weak degree of honesty, thus weakening tax efficiency.

There are many effects of tax evasion, including a decrease in revenue collection, which limits the general services that the country provides to society, and the country imposes additional taxes at higher tax rates. Tax evasion can also be reduced by using many methods, including reducing taxes and working to ensure accuracy and clarity in tax legislation, simplifying procedures for collecting taxes, setting deterrent penalties that are applied effectively, and increasing citizen awareness of the importance of paying taxes and the purpose for which the tax is paid to achieve his own benefit and the benefit that society obtains. (Flih Hassan Khalaf, 2008, p. 196).



Sudan has established support for anti-evasion devices:

These devices aimed to achieve the following:

- The simplicity of the tax system in Sudan and the cancellation of multiple taxes, customs duties, and production fees on goods and services.
- These agencies sought to achieve justice and remove all negative effects on production, investment, saving and consumption.
- Preventing double taxation, especially on production inputs.
- Increasing non-correlation tax revenues.

The government of Sudan sought to mobilize idle capacities in order to increase supply from the overall economy and processing the tax base for many industrial goods. The processing included both the field of in-correlation taxes and export taxes (Khaled Abdel Hafeez, 2021, p. 144).

Financial policy regarding general revenues in developing countries:

Financial policy must work, through progressive taxes, to increase the collection of tax revenues imposed on income, wealth, and capital, so that they are not imposed in a way that negatively affects economic activity. This ensures high tax revenues, so the state obtains the largest amount of taxes, and this limits... Resources are directed to unproductive activities. Within the framework of fiscal policy, ensuring the reform of the tax system in developing countries to many problems and their solutions in a way that raises tax revenues and reduces evasion, especially by those most able to pay. Reaching out to hidden activities through the underground economy in which many illegal activities are practiced. Hence, countries must address the reasons that drive such activities in order to make them general in accordance with the laws. Following up on unorganized economic activities that are not subject to regulations in their work and whose practice is expanding in developing countries in order to reach incomes and returns from which tax revenues can be collected. The financial policy must develop such activities and oblige them to confirm their activity through records and documents through which they know the returns and are authorized to increase the revenue collection. tax Increasing the revenues of general projects owned by the state by increasing the productive efficiency of productive projects in order to achieve a surplus in revenues or lower state costs Warning developing countries against loans as a source of general revenues, especially those that are used for consumer purposes, which makes debts obligatory, and therefore it is necessary to reduce them so that they do not negatively affect economic activity. Or those that make a positive contribution are loans that expand productive activity.



Finally, fiscal policy should not depend on issuing cash because most developing countries depend on it in order to expand general expenditures, and one of the effects of this policy is the inflationary impact on the economy. (Flih Hassan Khalaf, 2008, pp. 349-354)

4. Analysis methodology and study model estimation results:

4.1. Description of the study model:

The standard model for measuring the impact of tax revenues on economic growth and investment in Sudan during the period 2006-2021 includes a number of economic variables expressed by a mathematical function that is determined through the literature represented in economic theory and applied studies.

The study variables are:

- * Dependent variable: economic growth (GDP).
- * Independent variable: tax revenues (RT). Investment(INV)

It is expected that landmark signs will be as follows:

- 1- The sign of the constant is expected to be positive (B0), as it represents economic growth when all independent variables are equal to zero.
- 2- The sign for tax revenues (B1) is expected to be positive because there is a correlation relationship between tax revenues and economic growth.
- 3- The investment sign (B2) is expected to be positive because there is a correlation relationship between investment and economic growth.

4.2. Analysis results of the study model:

The practical application of the ARDL methodology includes three steps: determining the integration order of the variables under study using unit root tests, test of the existence of an integral relationship using the Bounds Testing Approach, and finally estimating the ARDL to obtain the short- and long-term processes. The following is a discussion for the results of the analysis of the study model:

A- Test of the stability of time series data (unit root tests):

The unit root test aims to examine the properties of the time series for all variables in the model during the study period, ascertain the extent of their stationary, and determine the degree of integration of each variable separately, as the condition of stationary is a basic condition for time series analysis to reach intact and logical results. Despite the multiple root tests Unit, the study



will depend on applying the Augmented Dicky Fuller test (ADF), in the event that there is a secant and a trend, and the estimation results are as shown in the following table.

In the first d	lifference	In the level		
ADF Value	P Value	ADF	P Value	Variables
		Value		
-5.88	0.0000	-1.023	-1.711	1- Economic growth
				(GDP)
-6.060	0.0001	-2.789	0.008	2- Tax revenue(TR)
-4.588	0.0026	-1.571	0.471	3- Investment (INV)

 Table No. (2) Results of the unit roots test for the study variables during the period (2006-2021)

Source: Prepared by the researcher from the study data based on the outputs of the E.Views12 program

It is clear from Table (2), based on the Extended Dickey-Fuller (ADF) test, that all variables (economic growth, tax revenues, investment) are not stationary at their levels. Therefore, the unit root tests were re-conducted again for these variables, and the results indicated the presence of stationary for these variables. After the first differences at a 5% significance level, this means that the time series for these variables are integrated of the first degree, and this is considered a good indicator of the effectiveness of using the co-integration test between the time series.

B- Co-integration test:

After obtaining the results of the unit root test for the time series of the study variables and determining the degree of integration for each variable in the study model. Also ensuring that they are not integrated of the second degree, therefore, the appropriate test for this is the bounds test for co-integration (Bounds Test) to verify the existence of a long-term complementary relationship between the variables under study. Since the ARDL model is considered very sensitive to time gaps, which necessitates determining the optimal lag period for the variables through the using different criteria (Al-Shorbagy, p. 157, 2009), which are: the final prediction error (FPE) standard, Accurate Information Standard (AIC). Schwarz Information Standard (SC), Hanan Quinn Information Standard (Q-H), Maximum Likelihood Ratio (LR) standard.

According to these standards, the optimal lag period is chosen which has the lowest value and on which most standards are agreed upon.



Log time	SC	AIC	FPE	LR	H.Q
0	38.72498	38.66446	2.13E+14	NA	38.59808
1	31.56156	30.6678	9.34567	2.267823	36.78904
2	7.17252*	36.99096*	4.14e+13*	17.31449*	36.7918
3	37.84156	37.53898	8.39E+13	1.259923	37.20704
4	37.46645	37.04283	8.19E+13	3.888455	36.57812*

Table	(3)	shows t	he results	of cho	osing the	ontimal lag	period for	the study	variables.
Lanc	(\mathbf{v})		ne results	or cho	und the	opulliar iag	, periou ioi	the study	variabico.

Source: Prepared by the researcher from the study data based on the outputs of the E.Views12 program

* Indicates the optimal number of lag periods chosen for each standard at a significance level (5%).

It is clear from Table (2) that the optimal number of lag periods, which is agreed upon by all the used standards and which has the lowest values for all the standards, is two lag periods, which are the ones that are used in estimating the study model. After determining the optimal lag periods for the model variables, a bounds test for co-integration is conducted, in which the null hypothesis states that there is no co-integration relationship between the variables. The results of this test are shown in Table (4) as follows:

Value	K	F – Statistic
	2	8.729
Significance	I(0) Bound	I(1) Bound
10%	2.61	3.35
5%	3.01	3.87
2.50%	3.55	4.38
1%	4.01	5

Table	<i>(1</i>)	Dear-14a of the	harrenda 4aa4	f	as interretion	~ ~ ~ ~ ~ ~	4 la a a 4 d	
I anie	(4)	Recuire of the	nonnae teet	Inr.	co_integration	among	της ετιτάν	varianies
Lanc	(-)	itcourte or the	bounds test	101	co-micgi anon	amone	mc study	vai iantos
	< /						•/	

Source: Prepared by the researcher from the study data based on the outputs of the E.Views12 program

Through Table (3), we find that the value of F reached (8.927), which is greater than the critical value of (3.87) at the 5% significance level, which confirms the existence of a co-integration relationship between the variables of the model, and this means the existence of a long-term



balanced relationship between each of the tax revenues, investment and economic growth during the study period.

4.3. Results of estimating the study model:

In light of the previously presented results of the stability test and ensuring the existence of a longterm equilibrium relationship between the dependent variable (economic growth) and the explanatory variables (tax revenues and investment), the ARDL model is estimated for the long and short terms and the error correction vector parameter (ECM) according to the equation shown in the previous paragraphs. Based on the number of lag periods specified according to the standard for choosing the lag period for all variables. All calculations for estimating the model were performed using the E-views12 program, as follows:

A- Estimating the relationship in the long term:

The results of estimating the ARDL model for estimating the relationship between tax revenues and investment as independent variables and economic growth as a dependent variable in the long term, shown in Table (4), showed the existence of a correlation, statistically significant relationship between tax revenues and economic growth in the long term, where the value of the regression coefficient reached (0.6487). With a level of significance (0.0146), which is a value lower than the level of significance (0.05), which indicates that a change in the volume of tax revenues by 1% increases economic growth at a rate of (0.65%). While the estimation results indicate that there is a correlation relationship between investment and economic growth in the long term, as the value of the regression coefficient reached (0.167), but it is not significance (0.05). As the coefficient of determination indicates (Adjusted R-squared) which had a value of 0.89, provided that the explanatory variable (tax revenues) explains 0.89% in the long term of the variance in the dependent variable (economic growth), while the remaining percentage of these changes (00.11%) can be traced back to other variables not included in the model. This result indicates the ARDL model is good quality in explaining tax revenues on Sudan's long-term economic growth.

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LOG (TR)	0.648734	0.201258	3.223391	0.0146
Log (INV)	0.167767	0.215122	0.779871	0.4610
С	3.694540	1.201564	3.074776	0.0179

Table (5) Estimation results of the long-term study model during the period (2006-2021)

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Source: Prepared by the researcher from the study data based on the outputs of the E.Views12 program

Log(GDP) = 3.694 + 0.648LogTR + 0.167Log(INV)

R-squared=0.997 Adjusted R-squared=0.995 F-statistic=30.06

Prob (F-statistic)=(0.0000).

B- Estimating the relationship in the short term:

The results of estimating the ARDL model showed that the study model was estimated in the short term using the error correction model, and the results were as shown in Table (6).

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
DLOG (TR)	1.484475	0.251626	5.899529	0.0006
CointEq (-1)*	0.812341	0.113737	7.142276	0.0002

Source: Prepared by the researcher from the study data based on the outputs of the E.Views12 program

 $D(GDP) = 1.484 \log(XP) - 0.8123 CointEq(-1)$

R-squared=0.93 Adjusted R-squared=0.91

It is clear from Table (5), which shows the results of estimating the ARDL model for the short term, that there is a correlation, statistically significant relationship between tax revenues and economic growth in the short term, where the value of the regression coefficient of the relationship reached (1.484) and a level of significance level (0.0006), which is a value less than the level of significance (0.05), which indicates that a change in the volume of tax revenues by 1% increases economic growth at a rate of (1.48%) in the short term. The Adjusted R-squared, whose value was (0.91), indicates that the explanatory variable (tax revenues) explains (91)% in the short term of the variance in the dependent variable (economic growth), while the remaining percentage of these changes (9%) can be returned to other variables not included in the model. This result indicates ARDL is good quality model in explaining the impact of tax revenues on economic growth in Sudan in the short term. The estimation results also indicate that the error correction coefficient has a negative sign and is significant, as the value of the error correction factor (CointEq(-1)) reached (-0.812) with a significance level of (0.0002). This value means that the deviation from the equilibrium relationship in the long term is corrected annually by (81)% to reach equilibrium, meaning that the dependent variable takes about a year and two months (1/0.812 = 1.2). Also, the significance of the error correction coefficient indicates the existence of a long-term equilibrium



relationship between the explanatory variable (tax revenues) and the dependent variable (economic growth).

4- Checking Model validity: The validity of the model is diagnosed by ensuring that the model meets a number of necessary standard criteria for the process of intact statistical inference. The most important of these standards is to verify the assumptions regarding the error limits, which are the observations of the random error limit are independent of each other and similar.

The distribution is normally distributed with zero mean and variance 2 and since it is unknown, the residuals are used instead. The results of verifying the validity of the model are as follows:

A- Results of the autocorrelation test for the residuals:

The following table shows the results of testing the null hypothesis that the residuals are not independent of each other using the Lagrange multiplier test (Breusch-Godfrey Serial Correlation LM Test) where the results indicate that there is no statistical evidence to accept the null hypothesis; Meaning that there is no autocorrelation for the residuals, as the value of the level of significance reached (0.254), which is a value greater than 5%.

 Table (7) Lagrange multiplier test for the independence assumption of residuals for a model Breusch-Godfrey Serial Correlation LM Test:

F-statistic	2.490	Prob. F(2,5)	0.239
Obs*R-squared	9.118	Prob. Chi-Square (2)	0.254

Source: Prepared by the researcher from the study data based on the outputs of the E.Views12 program

B- Results of testing the variance invariance hypothesis:

To ensure homogeneity of error (Breusch-Pagan-Godfrey test) was used. The following table shows the test results, which indicates that there is no statistical evidence to reject the null hypothesis, which means that there is no problem of variance, as the test value reached (0.642), which is a value greater than the level of significance level (5)%.

 Table 8: Breusch-Pagan-Godfrey test for the non-constancy of variance hypothesis:

F-statistic	0.509487	Prob. F(6. 7)	0.7853
Obs*R-squared	4.255466	Prob. Chi-Square (6)	0.6421
Scaled explained SS	1.013116	(Prob. Chi-Square)(6)	0.9851

Source: Prepared by the researcher from the study data based on the outputs of the E.Views12 program



C- Results of the normal distribution test for the error term:

The condition of normal distribution was verified using the Jarque-Bera test, and the results indicated that the test value was (0.528) with a probability value of 0.776, which is greater than the 5% significance level. This value indicates that the residuals follow the normal distribution at the 5% significance level.





Source: Prepared by the researcher from the study data based on the outputs of the E.Views12 program

D- Suitability test of the estimated model:

To verify the suitability, specification and design of the estimated model in terms of the functional form, the Ramsey test was used, and the results shown in Table (10) the probability value corresponding to the F-statistic reached (0.837), which is greater than the level of significance (0.05), which indicates acceptance. The null hypothesis states that the functional form of the estimated model is correct.

Table No. (10) Ramsey test results for the suitability of the functional form to the estimated
model

Probability	df	Value	
0.8372	6	0.214557	t-statistic
0.8372	(1, 6)	0.046035	F-statistic
0.7436	1	0.107005	Likelihood ratio

Source: Prepared by the researcher from the study data based on the outputs of the E.Views12 program



E- Structural stability test of the model parameters:

To know the consistency of the coefficients of the model variables in the long and short run, the Cumulative Sum of Residuals (CUSUM) test was used. According to this test, the structural stability of the coefficients estimated using the error correction formula for the (UESM) model is achieved when the graph line for the CUSUM statistic is confined within the critical graph lines at a significant level. (5%), while these coefficients are not characterized by stability if the statistical graph line falls outside the critical graph lines. In the estimated model, it is noted that the Cumulative Sum of Residuals (CUSUM) test falls within the critical limits at a significance level (5%), which indicates that There is stability and consistency in the model estimates between the long-term results and the short-term results, meaning that the estimated coefficients of the unconstrained error correction model used are structurally stable during the study period



Figure No. (2) Stability test for the study model

F- Model's predictive ability test:

Prediction is considered one of the important goals in econometrics, as it determines the path of the phenomenon in the future to help in the process of planning, control, and decision-making. Prediction studies the development of the phenomenon over time as a factor that shows the resultant effect of all factors affecting this phenomenon. Phenomena change with time from one month to another and from an year to another. Time itself is not an influential factor in the development of economic phenomena as it is an independent indicator objective of human action. However, time is inherent in the development of economic phenomena, and therefore it is possible to link the state of the phenomenon and the moment that corresponds to this condition, or between the developments of the phenomenon and the period of time during which those developments took place or will take place resulting from other factors than time that affect the



phenomenon and lead to its change in quantity and quality. It is possible to test the extent to which the estimated model can predict by using the Theil equality coefficient standard. It is clear from the estimation results shown in Table (10) that the value of the Thiel coefficient reached (0.75), which is a value close to zero. This result indicates that the estimated study model has an excellent ability to predict during the period under study, and this ability to predict can be observed through the figure (2) Which explains the behavior of the actual and expected values of economic growth in Sudan according to the estimated model. Accordingly, the results of this model can be relied upon for the purposes of analysis, policy evaluation, prediction, and economic decision-making.





Source: Prepared by the researcher from the study data based on the outputs of the E.Views12 program

5. Results and recommendations:

1.5. Results: The study reached the following results:

- The results of the stability tests for the series of study variables, using the unit root test, showed that all the variables under study (tax revenues, investment, and economic growth) are unstable at their levels, as they stabilized at the first difference.
- Through testing the limits, the study found that there is a co-integration relationship between tax revenues, investment, and economic growth.
- The study demonstrated the existence of a correlation, statistically significant relationship between tax revenues and economic growth in Sudan in both the long term and the short term during the study period.



- The study found that there is no correlation, statistically significant relationship between investment and economic growth in Sudan in both the long term and the short term during the study period.
- The study demonstrated the importance of the explanatory ability of tax revenues in economic growth, as the value of the coefficient of determination was (93%) in the short term and (99%) in the long term.
- The study found, through testing the error correction factor, that the deviation from the equilibrium relationship in the long term is corrected annually by 81% to reach equilibrium.

5.2. Recommendations: Based on the previous results, the study recommends the following:

- Working to improve the tax base and reduce tax evasion, as taxes have a positive impact on the gross domestic product.
- Expanding tax exemptions for investment projects that effectively contribute to increase production
- It is necessary to process many issues related to achieving long-term economic growth through reform of the tax system.
- Activating the digitization of tax administrations by facilitating electronic tax payment procedures.
- Encouraging investment because of its positive effects by expanding the production base and promoting growth.

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Supplements

Limit test for integration

relationsh	nip		F-Bounds	Test
I(1)	I(0)	Signif.	Value	Test Statistic
	Asymptotic n=1000	:		
3.35	2.63	10%	8.927119	F-statistic
3.87	3.1	5%	2	Κ
4.38	3.55	2.5%		
5	4.13	1%		
	Finite			
	Sample:			
	n=35		14	Actual Sample Size
3.623	2.845	10%		
4.335	3.478	5%		
6.028	4.948	1%		
	Finite			
	Sample:			
	n=30			

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2 (05	2.015	100/				
3.695	2.915	10%				
4.428	3.538	5%				
6.265	5.155	1%				
	Resul	ts of estimat	ing the long-t	erm model		
Levels I	Equation					
Case 2:	Restricted Co	onstant and N	lo Trend			
Prob.	t-Statistic	Std. Error	Coefficient	Variable		
0.0146	3.223391	0.201258	0.648734	LOG(TAX)		
0.4610	0.779871	0.215122	0.167767	LOG(INV)		
0.0179	3.074776	1.201564	3.694540	С		
EC = LC	DG(GDP) - (().6487*LOG	(TAX) + 0.16	78*LOG(INV) -	+ 3.6945)	
Short	-term model	estimation re	esults and err	or correction pa	rameter	
		EC	M Regression			
		Cas	se 2: Restricte	d Constant and I	No Trend	
		Pro	b t_Statio	stic Std Error	CoefficientV	ariable

Prob.	t-St	atistic	Std. Error	Coefficien	t Variable	
0.0044	-4.1	32933	0.379505	-1.568467	DLOG(GDP(-1))
0.2171	1.3	56445	0.122399	0.166028	DLOG(TAX)	
0.0006	5.89	99529	0.251626	1.484475	DLOG(TAX(-1))
0.0002	7.14	42276	0.113737	0.812341	CointEq(-1)*	
0.333892	2 N	/Iean dej	pendent var	0.931825	R-squared	
0.260506	5 S	.D. depe	endent var	0.911373	Adjusted R-squa	ired
-2.04074	2 A	kaike in	nfo criterion	0.077553	S.E. of regressio	n
-1.85815	5 S	chwarz	criterion	0.060145	Sum squared res	id
-2.05764	4 H	Iannan-(Quinn criter.	18.28520	Log likelihood	
				2.514840	Durbin-Watson	stat



GDP growth	GDP	Investment	taxes	Years
9.9	96,611.5	208,687	588.1	2006
10.9	106,527.0	136,645	6,530	2007
6.4	124,609.1	235,812	7,680,3	2008
5.9	135,659.0	253,796	8,655.8	2009
5.2	162,203.9	215,380	10,008.6	2010
2.8	186.689.9	340,929	11,183,3	2011
1.4	222,548.0	574,810	15,567.4	2012
3.6	304,116.0	768,286	24,133.7	2013
4.0	447,999.6	957,021	35,178.1	2014
7.0	505,760.7	832,167	41,963.3	2015
6.8	605,408.6	618,911	47257	2016
2.4	815,855.4	846,581	63849	2017
2.1	1,317,968.8	532,768	91,345	2018
6.5	1,950,330.2	776,836	114,060	2019
6.2	4,727,134.7	118,573	159,949	2020
143.6	11,417,292.2	116,196	639,433	2021

A table showing the data that the researcher relied on to reach the results of the study

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A Comprehensive Review of Artificial Intelligence Algorithms Applications for Distributed Generation Sizing and Location Optimization to Enhance Efficiency and Reliability Indices in Radial Distribution Systems

Nawaf Ali H. AlZahrani¹, Mohammad Hamza Awedh², Ali M. Rushdi³

Department of Electrical and Computer Engineering, King Abdulaziz University, Jeddah, 21589, Saudi Arabia^{1,2,3}

Email: Nalzahrani0588@stu.kau.edu.sa

Abstract:

The research aimed to understand radial distribution systems by defining them and exploring their strategies, and to explore methods for applying artificial intelligence algorithms in radial distribution systems, It also aimed to clarify types of indicators in radial distribution systems, highlighting the importance of providing a scientific and applied framework for integrating artificial intelligence in the field of energy distribution.

The significance of the research lies in presenting a comprehensive and up-to-date approach based on the applications of artificial intelligence algorithms to improve the design and organization of distributed production systems in radial distribution systems.

By employing a descriptive and analytical approach, the researcher was able to reach several conclusions, with the most prominent being that the application of artificial intelligence algorithms in radial distribution systems contributes to improving energy efficiency by directing it more accurately and effectively, the ability of artificial intelligence to provide precise data-dependent analyses enhances decision-making processes in radial distribution systems, The integration of artificial intelligence techniques contributes to improving overall efficiency in radial distribution systems, reducing energy losses, and enhancing energy distribution effectively.

The research recommends enhancing integration between artificial intelligence techniques and radial distribution systems to ensure effective and smooth interaction, thereby increasing efficiency, Priority should be given to the safety and protection of data, and effective cybersecurity measures should be implemented to address the growing challenges in this context.

Keywords: Radial distribution systems, Production site, Technology, Artificial intelligence algorithms, Indicators, Efficiency, Reliability.



1. Introduction

The fields of electrical engineering and radial distribution systems are undergoing rapid evolution in the face of continuous technological advancements. Radial distribution systems play a crucial role in efficiently and reliably delivering electrical power. With recent developments in artificial intelligence (AI), attention is shifting toward integrating these technologies to enhance the efficiency and reliability of such systems.

This comprehensive review sheds light on the applications of AI algorithms in the identification and improvement of distributed production sites in radial distribution systems. The research primarily addresses the urgent need to enhance energy efficiency and increase the reliability of these systems, with AI playing a vital role in achieving these goals.

The review conducts a thorough analysis of available literature in this field, examining studies and research that highlight the concepts of AI and its applications in improving radial distribution systems. The research delves into the specific objectives of various studies, the methodologies employed, and focuses on the key results and recommendations provided by these studies.

Particularly, the research concentrates on defining and determining the locations of distributed production, exploring how this process can be enhanced using AI algorithms. The aim of this research is to provide a deep understanding of how modern technology integration can boost the performance of radial distribution systems, ensuring sustainable and reliable provision of electrical energy.

1.1. Research Problem

The scientific problem addressed in this research may revolve around the inefficiency and unreliability in identifying and improving the locations of distributed production in radial distribution systems. Challenges related to current distribution technology might render traditional methods for site identification ineffective in meeting efficiency and reliability requirements. Difficulties in handling big data and complex interactions within distribution systems underscore the necessity of using AI techniques to enhance decision-making processes in this context.

In general, the research problem may focus on overcoming technical and organizational challenges associated with improving the identification and enhancement of distributed production sites using AI algorithms. Understanding how these technologies can be effectively integrated into electric distribution environments is also crucial.



1.2. Research Questions

- 1. How can the efficiency of identifying distributed production sites in radial distribution systems be improved using AI techniques, and what are the key factors that must be considered to achieve this?
- 2. How does the location and sizing improvement of distributed production sites through AI impact reliability indicators in radial distribution systems, and what challenges may arise in the widespread implementation of these technologies?
- 3. Are there tangible benefits, supported by data and statistics, for using artificial intelligence algorithms to enhance distributed system, and how can the impact of these technologies on the performance of radial distribution systems be measured?
- 4. What practical recommendations exist for effectively and sustainably integrating artificial intelligence technologies into radial distribution systems?

1.3 Research Objectives

- 1. Understand radial distribution systems, defining them and exploring their strategies.
- 2. Explore methods for applying artificial intelligence algorithms in radial distribution systems.
- 3. Clarify types of indicators in radial distribution systems.
- 4. Highlight the contribution of artificial intelligence in enhancing the efficiency and reliability of indicators.
- 5. Identify the characteristics and challenges of artificial intelligence in radial distribution systems.

1.4. Research Significance

In general, this research contributes to providing a scientific framework for integrating artificial intelligence in the field of energy distribution. It enhances the sustainability and efficiency of radial distribution systems, contributing to the smart transformation in the energy sector. The scientific significance lies in providing a deep understanding and comprehensive analysis of the impact of artificial intelligence technology on the identification and improvement of distributed production sites in radial distribution systems. The research can contribute to expanding knowledge about the integration of modern technologies in electrical engineering and providing an understanding framework for applying artificial intelligence to enhance the performance of distribution systems.



1.5. Research Methodology:

The research employ an integrated analytical and descriptive methodology to comprehensively achieve its objectives. By using these methodologies together, data can be analyzed deeply, and processes and techniques can be accurately described, contributing to highlighting the impact of artificial intelligence technology on improving the efficiency and reliability of radial distribution systems.

1.6. Research Terms:

1.6.1. Artificial Intelligence Algorithms: These are a set of mathematical and logical guidelines designed to solve complex problems. They rely on knowledge representation techniques and machine learning to make intelligent decisions based on data. (Al-Asyuti, 2020, p.21)

1.6.2. Artificial Intelligence Applications: They are smart applications that use machine learning and integrated algorithms to enhancing efficiency, productivity, and problem-solving capabilities. (Al-Hadi, 2021, p.33)

1.6.3. Distributed Generation System: It is the process of determining the size and locations of dispersed electricity generation sources in multiple locations instead of a single large source. It aims to improve energy efficiency and distribution. (N.H. Khan, 2021, p.47981)

1.6.4. Distributed Generation Location: Refers to the geographical locations where energy generation sources are distributed. It is determined based on factors related to efficiency and sustainability in energy distribution systems. (N.H. Khan, 2021, p.47982)

1.6.5. Radial Distribution Systems: Refers to the structure and networks used to transmit electrical energy from the generation source to consumers through transmission lines and distribution networks. (T.T. Nguyen, 2021, p.1771)

1.6.6. Indicators in Radial Distribution Systems: These indicators include various measurements and evaluations used to determine the efficiency and reliability of radial distribution systems. These indicators may include loss rates, operation time, network strength, voltage performance, and others. (T.T. Nguyen, 2021, p.1771)

2. Literature review:

In this review efforts were made to remain closely aligned with the topic of electrical distribution systems, by surveyed the recent studies in scientific databases like IEEE, google scholar, ResearchGate, and EBSCO etc, for last six years.



1) Fadel Juma (2021) the optimal situation for distributed generation using artificial intelligence to improve the active radial distribution system. Distributed generator (DG) units offer various advantages aimed at enhancing the security of distribution power grids. However, these benefits can be optimized through careful sizing and positioning of DG units, as the arbitrary placement of DG units may have adverse effects on power grids, leading to increased power loss and deterioration of the voltage profile. Consequently, multiple approaches have been proposed to ensure the optimal positioning and sizing of DGs. The main objective of this article is to establish a technique for the optimal scheduling and operation of DGs, with the goal of reducing power loss, improving the voltage profile, and enhancing overall network reliability. The researcher mentioned some techniques improving reliability and reducing power loss for example: Simulated Annealing (SA), Machine learning (ML) technique, And for finding the appropriate DG allocation: An improved analytical (IA) technique, Artificial bee colony (ABC) technique, and Cuckoo search (CS) technique, and for power loss reduction Strategies are adopted with renewable DGs: ant lion optimization, a Backtracking search algorithm (BSA), Flower pollination algorithm (FPA) is also utilized for determining size and location of DG. This article employs an artificial intelligence method known as particle swarm optimization (PSO) to identify the optimal site and size for DGs, resulting in decreased power loss and an enhanced voltage profile. This study will execute a detailed performance analysis on 33 bus network with the aim of establishing the robustness of the presented PSO method.

2) SIMON et.l, (2021) Applications of Artificial Intelligence in Distribution Power System Operation. This review explains a comprehensive concept about the methodology of algorithms for artificial intelligence in general, and the control systems in power distribution networks, Both types are open, in which human control is involved, and closed, in which artificial intelligence is used in control and prediction, the researchers discussed analyzing power quality, system and voltage stability, locating and isolating the fault, emergency procedures, analyzing economic efficiency, reducing the cost of generation and carbon emissions, coordinating emergency actions, and the AI's algorithms used for this, including: the digital twin, using a deep neural network, fuzzy algorithm, RELIEF algorithm, and biogeography-based optimization algorithm and learning.

3) Olufemi &, Haoran (2021). Artificial Intelligence Techniques in Smart Grid: A Survey, In this article the researchers reviewed 148 studies is this paper related to: load forecasting, power

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grid stability assessments, faults detection, and smart grid securit. for Short-Term Load Forecasting, mentioned that wavelet neural network (WNN) and ANN schemes showed the higher performance of the proposed mode, comparing it with other clustering methods . For Mid-Term Load Forecasting and Long-Term Load Forecasting a neural network-based model with particle swarm optimization (PSO) and showed the feasibility and validity of the model. The researchers mentioned many Techniques for power grid stability assessments, faults detection, and smart grid security, most used was ANN, and machine learning. Regarding the challenges for the future of artificial intelligence in smart networks, hacking and cybersecurity pose a major challenge with the integration of the network into cloud computing and the availability of fifth-generation infrastructure.

4) Khan et al, (2022). Optimal Sizing and Allocation of Distributed Generation in the Radial Power Distribution System Using Honey Badger Algorithm. In this article, the researchers discussed the Optimal Sizing and Allocation of Distributed Generation in the Radial Power Distribution System, as the optimal allocation is a non-linear problem, which is solved by powerful metaheuristic optimization algorithms. In this work, an objective function is introduced to optimally size four different types of DGs by utilizing honey badger algorithm (HBA), and comparison is drawn with grey wolf optimization (GWO) and whale optimization algorithm (WOA). The objective is to boost the voltage profile and minimize the power losses.

5) J. Watson, et al, (2016), Impact of solar photovoltaic on the low-voltage distribution network in New Zealand. Examined the influence of solar Photovoltaics on the low-voltage distribution network in New Zealand, presenting power flow outcomes with the integration of different solar PV penetration levels into the model. The simulation results indicate that elevated PV levels result in conductor overloading. Consequently, an investigation into the potential maximum limit of solar PV penetration was conducted. The simulation also explored the impact of employing voltage regulation through PV inverters and proposed measures to address overvoltage issues. The findings suggest the anticipation of additional challenges in the future.

3. Theoretical Framework:

Artificial Intelligence represents an exciting field witnessing rapid developments, actively transforming numerous sectors. Among these sectors, the spotlight is on the Radial Distribution Systems for electrical power, given that Artificial Intelligence serves as a fundamental pillar in the modern technological landscape.



Its ability to achieve significant transformations across various domains is noteworthy. The impact of Artificial Intelligence is closely linked to enhancing the effectiveness of systems and innovatively developing them. Notably, one of the systems undergoing significant transformation is the Radial Distribution Systems for electrical power. (Al-Asyuti, 2020, p.27)

This study addresses specific topics related to this context, focusing on the importance and role of Radial Distribution Systems in efficiently securing energy supplies with reliable dependence. The investigation explores the impact of using Artificial Intelligence in this context and how Artificial Intelligence techniques can play a vital role in improving and developing Radial Distribution Systems. The research includes an analysis of key indicators that assess the performance of these systems, shedding light on the characteristics and challenges of employing smart technology in this context. This study aims to gain a profound understanding of how advancements in Artificial Intelligence can be integrated to enhance efficiency and sustainability in electrical power distribution systems.

3.1. Radial Distribution Systems

3.1.1. Explanation of Radial Distribution Systems

Radial Distribution Systems are an essential part of the infrastructure for electrical power distribution. These systems transport and direct energy from generation stations to consumers through complex networks. This is achieved through a set of devices and equipment that enable efficient and effective energy routing. The design and operation of these systems aim to achieve balance and stability in electricity distribution. These systems continuously evolve to become more intelligent and efficient. Artificial Intelligence contributes to advancing their operation and management, enhancing energy distribution efficiency, and contributing to sustainability goals. (N.H.Khan, 2021, P47983)

3.1.2. Distributed Generation in Radial Distribution Systems

Distributed generation in Radial Distribution Systems refers to generating electrical power from diverse and widely distributed sources, rather than consolidating in a single source. This includes utilizing various sources such as solar cells, wind energy, and microgenerators. This approach allows reducing energy loss during its transmission across the network, promoting sustainability. Strategically distributing points of distributed generation meets the needs of consumers at the neighborhood or residential levels. Distributed generation enhances network stability and improves its adaptability to changing energy demand challenges.



Artificial Intelligence plays a role in enhancing the operation of these distributed systems by improving energy routing and efficiency. (Z. Hamadouche, 2021, P101)

3.2. Distributed Generation Sizing and location in radial distribution systems:

Determining and directing distributed generation in Radial Distribution Systems refer to the process of identifying effective locations for energy generation within the distributed network. This approach is a vital part of strategies to improve energy distribution. Production locations are determined based on factors such as energy needs in the area and opportunities to utilize renewable energy sources like solar and wind. Control and monitoring systems benefit from Artificial Intelligence techniques to analyze energy data and maximize the use of diverse production sources. Artificial Intelligence can dynamically guide production based on demand and environmental conditions, improving network balance and increasing its efficiency. Determining and directing distributed generation is a key aspect of sustainability and improving the performance of Radial Distribution Systems. (N.H.Khan, 2021, P47989)

3.2.1. Definition of Distributed Generation Sizing:

Distributed generation identification refers to the process of determining and directing the production of electrical energy from diverse and widespread sources within various locations across a wide scale within the power distribution system. This approach aims to enhance energy efficiency usage and promote the sustainability of the electrical system. It involves the use of artificial intelligence techniques and smart control systems to analyze energy data and make effective decisions regarding the locations of distributed energy generation. The goal is to improve production direction flexibly based on energy needs and changing conditions.

Types of distributed generation sizing approaches: Peak Load Sizing, Average Load Sizing, Hybrid System Sizing, Renewable Sizing, Grid Support and Ancillary Sizing.

3.2.2. Distributed Generation Methodologies and Influencing Factors: (T.T. Nguyen, 2021, p.1772)

- 1. Load and Consumption Analysis: Examines energy consumption in the target area and determines expectations for electric load, utilizing load prediction models and statistical analysis to estimate future requirements.
- 2. **Geographic Site Evaluation:** Studies the environment, topography, and geographical conditions to identify optimal locations for energy generation. It relies on criteria such as sun availability and wind speed to determine the suitability of renewable energy sources.



- 3. **Cost Economics Analysis:** Involves estimating the financial cost of implementing distributed projects, including cost-benefit analysis and assessing long-term investment value.
- 4. **Production Technology:** Requires an examination of requirements and techniques for available energy sources, such as solar, wind, and microgenerator technologies, including a study of energy conversion techniques and their production efficiency.

It is also to take into account the application of the methodology for improving the DGs: Identify the locations with high voltage drop and low voltage levels, as these are potential sites for DG installation, Using iterative methods or optimization algorithms to find the DG capacity that provides the maximum reduction in power losses, Sizing DG units to improve voltage levels and maintain them within acceptable limits, Identifying critical nodes where small changes in DG capacity can significantly affect system parameters, Using financial metrics such as Net Present Value (NPV) or the Levelized Cost of Electricity (LCOE) to assess the economic feasibility of different DG sizes, Determining the ability of DG units to provide backup power during outages and their impact on system reliability indices, Consideration of the intermittency and variability of renewable sources and their impact on system stability, Using dynamic simulation tools to assess the transient behavior of the distribution system with integrated DG, Evaluating the impact of DG on system stability, voltage regulation, and fault response.

Influencing Factors:

- 1. **Energy Demand:** Estimating energy consumption in the region influences the volume and direction of distributed energy production.
- 2. **Technology Used**: The type and efficiency of the technology used affect the costs and performance of energy production.
- 3. **AI-Guided Flexibility**: The use of artificial intelligence techniques in flexibly directing energy production based on changing conditions.
- 4. **Policies and Legislation**: Local laws and regulations play a role in guiding policies related to distributed production and determining permissible locations.
- 5. **Sustainability and Environmental Impact:** Verifying the alignment of distributed production projects with sustainability goals and reducing environmental impact.

3.2.3. Definition of Distributed Generation location:

A distributed generation site refers to carefully selected geographical locations for implementing electrical energy generation from diverse and widespread sources, such as solar or wind energy,


on a broad scale within the electrical distribution system. The aim is to improve the sustainability and efficiency of the grid. Another source states that the distributed generation site in Radial Distribution Systems represents the specified optimal locations within the electrical distribution system where energy is generated from various sources. These locations are chosen based on geographic and technological criteria to achieve the best distribution and utilization of energy.

3.2.4. Optimal Distributed Generation placement Strategies: (Prakash, Khatod, 2015, p115,118)

- 1. Load and Consumption Analysis: by Analyzing historical load data to identify locations where DG can best match the load profile, reducing transmission losses and enhancing system efficiency.
- 2. **Voltage Improvement :** by Identifying locations with voltage violations or low voltage levels and install DG units to improve the overall voltage profile
- 3. **Integration of AI Technologies:** Relies on using artificial intelligence techniques to analyze data and make accurate decisions about the locations of distributed energy generation, including the use of algorithms and predictive models for optimal network performance improvement.
- 4. **Geography and Environment Analysis:** Relies on the analysis of geography and environmental conditions to effectively determine diverse energy generation locations, taking into consideration the availability of natural resources such as sun and wind and guiding the selection of high-efficiency locations.
- 5. **Cost Economics Assessment**: Relies on a meticulous evaluation of costs and financial benefits for each potential site to strike a balance between efficiency and cost, including a study of investment costs and operational and maintenance costs.
- 6. **Resilience and Security**: Takes into account critical infrastructure points and install DG units strategically to ensure a resilient power distribution system in the face of unforeseen events or attacks.
- 7. **Demand Response Integration:** Identifying locations with high demand during peak periods and install DG units to support demand response initiatives, reducing strain on the grid during peak hours.



3.3. Application of Artificial Intelligence Algorithms in Radial Distribution Systems3.3.1 AI Algorithms Used in Radial Distribution Systems:

Artificial intelligence contributes to the radial distribution system through machine learning, artificial neurons, and predictive ability based on historical data in predicting loads, regulating voltage, detecting and diagnosing faults, Optimal Reconfiguration, Volt/VAR Control, and Distributed Energy Resources. (Yahya Taher et al, 2022, P14038), Below we mention the most important algorithms that rely on artificial intelligence:

- **1. Particle Swarm Optimization (PSO):** Employed to enhance energy distribution and identify efficient generation locations using search and optimization techniques.
- 2. Ant Colony Optimization (ACO): optimize the integration of distributed energy resources, such as solar panels or energy storage devices, into the distribution system.
- **3.** Artificial Neural Networks (ANN): Rely on artificial intelligence models inspired by the human brain to analyze and predict load patterns and optimally direct production. In addition, it can learn patterns from historical load data and can predict future demand based on various factors such as time of day, day of the week, and season.
- **4. Machine Learning Algorithms:** Leverage the system's ability to learn from data and adapt responses over time to improve network performance. These algorithms can identify when maintenance is likely needed.
- **5. Genetic Algorithms**: Used to determine the optimal balance between performance and cost through simulating evolution and adaptation. And explore different configurations to find the most efficient layout in terms of losses, reliability, or other specified criteria.
- **6. Decision tree algorithms:** used for fault diagnosis by creating a tree-like model that represents the decision-making process based on observed symptoms.
- **7. Fuzzy Logic Systems:** Employed for fault detection and diagnosis in distribution systems.
- **8. Smart Aggregation:** Utilized to efficiently gather and analyze data to understand load behavior and suggest improvements in production distribution.
- **9. Intelligent Decision Algorithms:** Depend on making enlightened decisions automatically using available data to enhance energy distribution management.
- **10. Reinforcement learning algorithms:** used for Volt/VAR control to optimize voltage levels and reactive power flows in the distribution system.



- **11. Multi-objective Optimization Algorithms:** Algorithms like NSGA-II (Non-dominated Sorting Genetic Algorithm II) or MOEA/D (Multi-Objective Evolutionary Algorithm based on Decomposition) can be used when multiple conflicting objectives need to be considered in the optimization process.
- **12. Prediction and Analysis Algorithms**: Employed to analyze previous consumption records and forecast future needs based on efficient prediction models.

The use of these algorithms can significantly contribute to improving the performance of Radial Distribution Systems and achieving a balance between efficiency and sustainability.

3.3.2 Application of Artificial Intelligence Algorithms in Sizing Optimization:

The application of artificial intelligence algorithms in optimizing the identification of distributed energy generation sizing is a fundamental aspect of developing Radial Distribution Systems. These algorithms provide efficient methods to enhance energy utilization and increase the efficiency of these systems. Researchers benefit from intelligent optimization algorithms to analyze big data and guide decision-making processes toward identifying optimal locations for energy generation. These algorithms analyze future loads and environmental variables such as sun and wind, providing accurate guidance on locations that best suit the system's requirements. (Yahya Taher et al, 2022, P14041)

Below we will mention two examples with an explanation of their working mechanism.

1- Artificial Neural Networks (ANN) for Predictive Analysis:

Artificial Neural Networks (ANN) in radial distribution systems involves the use of machine learning techniques to determine the most suitable size and location for distributed generators within a power distribution network, Here's a general overview of how this process work: 1- Gather historical data on the radial distribution system, including load profiles, system topology, and operational constraints, line capacities, transformer capacities, and other relevant parameters, 2- Identify the relevant features and parameters that will be used as input to the ANN, 3- Normalize and preprocess the data to ensure that it is suitable for training the neural network, 4- Design the architecture of the Artificial Neural Network, 5- Using historical data to train the ANN. During training, the network learns the relationships between the input features and the optimal DG size, 6- Validation the trained ANN using a separate set of data that it has not seen before, once the ANN is trained and validated, it can be used to predict the optimal DG size for new scenarios and Integrating the ANN into the decision-making process for DG placement and sizing.



Decision-makers can use the ANN predictions along with other relevant factors to make informed decisions on where and how large the DG units should be installed.



Figure 1. Sample artificial neural network architecture, (Steven & Narciso, 2003)

2- Deep Q-Learning, Reinforcement learning algorithms:

Deep Q-Learning (DQL) is a reinforcement learning technique that combines deep learning with Q-learning, a classical reinforcement learning algorithm. It has been applied to optimization Distributed Generation (DG) Sizing in radial distribution systems. Here's a general overview of how this process work: 1- state the system includes information about the current configuration of the distribution system, load levels, and the presence of existing DG units, 2- Define a reward function based on the chosen actions such as (voltage stability, reduce power losses, and improve overall system reliability), 3- Implement a deep neural network (Q-network) that takes the state as input and outputs Q-values for each possible action, 4- Training the Q-network using historical data or simulation results, during training, the Q-network is updated iteratively based on the temporal difference between predicted Q-values and actual rewards. 5- Exploration and exploitation: During training, once the Q-network is trained, it can be used to predict optimal DG sizing decisions for a given state of the distribution system.

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Figure 2. Q-learning algorithm flowchart. (Fangyuan et al., 2019)

3.3.3. Application of AI Algorithms in optimal placement of distributed generation

Artificial intelligence is used to determine the optimal distribution location, especially regarding the diversity of generation sources. Below we will mention two examples with an explanation of their working mechanism.

1- Genetic Algorithms for Optimal DG Placement:

Genetic Algorithms can be applied to solve the optimal DG placement problem in a radial distribution system by represented each potential solution as a set of variables that correspond to possible locations for placing DG units, These variables may represent bus numbers or line sections where DG units can be installed, then Define an objective function that quantifies the performance of a particular solution based on the goals of the optimization, such as minimizing power losses, improving voltage profile, or achieving a balance between conflicting objectives. Then representing each potential solution as string corresponds to a decision variable (DG placement location). then Creating an initial solution represents a possible arrangement of DG units in the distribution system, then Evaluating the fitness of each solution in the population using the objective function According to the optimization criteria. Then Using a selection mechanism to choose solutions with higher fitness values are more likely to be selected, then recombination and Replacement.



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2- Particle Swarm Optimization (PSO):

Particle Swarm Optimization (PSO) is a metaheuristic optimization algorithm inspired by the social behavior of birds and fish. It's often used to solve optimization problems, including optimal Distributed Generation (DG) placement in radial distribution systems. The goal of optimal DG placement is to determine the best locations for placing DG units in a power distribution network



to improve its overall performance, such as minimizing power losses, voltage deviations, or enhancing system reliability. Here's a basic overview of how PSO works for optimal DG placement in a radial distribution system: 1- Defining an objective function that represents the goal of the optimization problem such as minimizing power losses, voltage deviations, or other relevant performance indices, 2- Representing each potential DG placement as a particle in the search space, 3- Initializing a population of particles randomly within the search space, 4- Evaluating the fitness of each particular DG placement configuration performs then updating particle velocity and position by using specific function, then the algorithm aims to find the optimal locations (nodes in the distribution system) for placing DG units such that the overall system performance is improved., other swarm intelligence algorithms can be used such as bee algorithms or firefly algorithms may be employed for optimization tasks.



Figure 4. Flow chart of PSO algorithm for the distribution network. (Waseem et. al, 2021)

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3.4. Indicators in Radial Distribution Systems

3.4.1 Types of Indicators in Radial Distribution Systems:

These indicators are based on diverse requirements that align with the goals of radiant distribution, providing comprehensive support for performance assessment and system improvement:

- 1. Efficiency Indicators: Evaluate the system's efficiency in energy distribution, including energy conversion and transmission efficiency.
- 2. Sustainability Indicators: Measure the system's ability to sustain and meet current needs without adversely affecting the future.
- 3. Power Quality Indicators: Relate to the quality of distributed energy, such as voltage levels, current, and load balance.
- 4. Consumption and Demand Indicators: Measure actual energy consumption and estimate future demand.
- 5. Safety and Reliability Indicators: Concern the system's ability to handle challenges and ensure reliable energy supply.
- 6. Technology Indicators: Measure the effectiveness and efficiency of the technology used in the radiant distribution system.
- 7. Economic Indicators: Relate to the costs and financial savings associated with the operation and maintenance of the system.

3.4.2. Importance of Enhancing Efficiency and Reliability of Indicators

Enhancing the efficiency and reliability of indicators in Radial Distribution Systems is of significant importance. By improving indicator efficiency, the overall system performance can be enhanced, leading to improved resource utilization and increased reliability. Enhanced indicators contribute to cost reduction and promote a balance between efficiency and economy. Making indicators more reliable also facilitates the achievement of sustainability goals and minimizes environmental impacts. Moreover, they aid in guiding strategic decisions and meeting user needs. In general, focusing on enhancing the efficiency and reliability of indicators contributes to achieving a comprehensive balance between performance and sustainability in Radial Distribution Systems.

3.4.3. AI's Contribution to Enhancing Efficiency and Reliability Indices

Artificial intelligence significantly contributes to enhancing the efficiency and reliability of indicators in radial distribution systems through various means: (Bilal, 2019, pp. 23-26)



- **Big Data Analysis:** Artificial intelligence enhances the efficiency and reliability of radial distribution systems by effectively analyzing massive amounts of data. This analysis helps extract accurate information about system performance and understanding its dynamics.
- **Improving Control Systems:** Artificial intelligence techniques are applied to control systems to balance production and consumption better, leading to improved energy direction and utilization.
- Enhancing Prediction: Artificial intelligence contributes to improving the predictive capabilities of system states and future changes, enabling more intelligent and effective decision-making.
- **Resource Utilization Improvement:** Distribution systems benefit from improved resource direction and utilization using artificial intelligence techniques, contributing to increased system efficiency.
- **Quality of Energy Improvement:** Artificial intelligence techniques are used to control energy quality, reducing interference and ensuring the provision of high-quality energy.
- **Predictive Maintenance:** Predictive maintenance systems can be implemented using artificial intelligence, reducing downtime and improving system reliability.
- **Improving Integration:** Artificial intelligence is integrated into distribution systems to enhance integration between different elements and achieve more distinguished performance.
- Enhancing Network Technology: Artificial intelligence techniques are used to improve the design and operation of network technology, enhancing its efficiency and flexibility.

Artificial intelligence applications and algorithms also improve performance indicators by reducing the Total Distribution System Losses, Substation Losses and Regulation the Voltage, improve the System Reliability Indices (SAIDI, SAIFI, MIFI, SART, CAIDI, CAIFI, VSI, FOM), Power Factor at Various Nodes, Load Distribution, Fault Detection and Restoration Time, Grid Stability with Distributed Generation, Implementation of Smart Meters, Automation and Remote Monitoring. Through these methods, artificial intelligence demonstrates a positive impact on enhancing the efficiency and reliability of radial distribution systems.

4. Conclusion:

In conclusion, it is evident that artificial intelligence constitutes a qualitative leap in the development of radial distribution systems for electrical energy. By analyzing vast amounts of data



and improving decision-making processes, artificial intelligence can enhance energy direction and predict future events. Despite challenges such as data security and achieving a balance between safety and efficiency, the undeniable benefits of integrating artificial intelligence technologies into radial distribution systems are apparent. Research and innovations in this field are expected to continue, further enhancing the ability to achieve sustainable and effective improvements in energy distribution systems.

4.1. Results:

- Studies demonstrate that the application of artificial intelligence algorithms in radial distribution systems contributes to improving energy utilization efficiency by directing it more accurately and effectively.
- 2. The ability of artificial intelligence to provide accurate, data-driven analyses enhances decision-making processes in radial distribution systems.
- 3. Artificial intelligence techniques enable better energy direction, contributing to achieving an optimal balance between production and consumption.
- 4. Studies observe progress in the predictive capabilities of artificial intelligence-supported radial distribution systems, enhancing the sustainability and reliability of these systems.
- 5. The integration of artificial intelligence technologies contributes to overall efficiency improvement in radial distribution systems, reducing energy loss and effectively improving energy distribution.
- 6. Artificial Intelligence techniques generally rely on self-learning from historical and input data and training before being applied.
- 7. An appropriate AI's algorithm is used based on the situation, and the desired solution and the problem.
- 8. The most important challenges facing the application of artificial intelligence algorithms in the radial distribution system are the cyber threat and the availability of smart infrastructure such as integration with the fifth generation network.

4.2. Recommendations:

 It is recommended to enhance integration between artificial intelligence technologies and radial distribution systems to ensure effective and seamless interaction, maximizing efficiency.



- 2. Data integrity and protection should be prioritized, and effective cybersecurity measures should be developed to address the growing challenges in this context.
- 3. Effective strategies should be developed to train smart systems to maximize the benefits of artificial intelligence capabilities and ensure their responsiveness to changing conditions.
- 4. Encouragement is given to raise awareness and train professionals in the field of radial distribution systems about the benefits and uses of artificial intelligence to ensure effective and secure adoption.
- 5. Continued research and development in artificial intelligence technology are encouraged to improve techniques and expand their applications in radial distribution systems.
- 6. Developing the infrastructure of traditional distribution system and replacing them with smart networks.

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Quality And Factors influencing Healthcare in KSA (Systemic literature review)

By:

Maha Zaid Alenazi

Health Management Bachelor, King Saud Medical City -Riyadh, Saudi Arabia Email: <u>alenazialenazi4@gmail.com</u>

Tahani Yahya Hakmi

Health Management Bachelor, King Abdullah bin Abdulaziz University Hospital -Riyadh, Saudi

Arabia

Amani Mohammed AlMubarak

Health Management Bachelor, National Guard Hospital -Riyadh, Saudi Arabia

Abstract

The aim of this review is to identify the factors that impact the quality of healthcare service in KSA based on locally published studies, There are a several factors that contribute to the quality of healthcare in KSA from the perspective of patients and healthcare providers (HCPs) and nurses. Factors such as infrastructure and device availability, emotional, social, and physical support, clinic duration time and appointment availability, HCPs experience and competencies, and specialists and drugs availability were identified as important for quality healthcare. HCPs and nurses in KSA prioritize delivering care that meets international standards, embracing evidence-based practices, and valuing continuous professional development. They also emphasize the significance of patient-centeredness, interdisciplinary teamwork, and respecting patients' cultural beliefs. A robust regulatory framework, healthcare services. Additionally, healthcare management and information, hospital supervision, and training and development programs for HCPs were identified as important factors for improving the quality of healthcare in KSA.

In conclusion, several factors have shown to be impacting quality of healthcare service in KSA, Policymakers and healthcare providers in KSA shall strive to improve the quality of healthcare services by acknowledging and tackling these factors.

Keywords: Healthcare system, Services, KSA, Saudi Arabia, Patients, HCPs



1. Introduction:

Healthcare quality is a critical aspect of any healthcare system, as it directly affects the well-being and outcomes of patients. Kingdom of Saudi Arabia (KSA) has made significant strides in improving its healthcare system in recent years. This essay explores healthcare quality in KSA and identifies the key factors that influence it according to Allen-Duck et al. (2017).

KSA has invested heavily in its healthcare infrastructure, aiming to provide accessible and highquality healthcare services to its population. The country has developed an extensive network of hospitals, clinics, and healthcare centers across its regions. The Ministry of Health (MOH) in KSA oversees the planning, development, and management of healthcare facilities, ensuring adequate Infrastructure is in place according to Vision 2030 (2022).

Regulatory bodies play a crucial role in ensuring healthcare quality by setting standards and monitoring compliance. In KSA, the Saudi Central Board for Accreditation of Healthcare Institutions (CBAHI) accredits healthcare facilities and ensures their adherence to established quality standards according to CBAHI (2022). Accreditation by CBAHI has become a benchmark for healthcare quality in the country, driving facilities to improve their performance..

The quality of healthcare providers is a crucial factor in ensuring the delivery of effective and efficient healthcare services. In KSA, the focus on enhancing healthcare quality has gained significant attention recently. This essay explores the quality of healthcare providers in KSA and identifies the key factors influencing their performance according to Saunders et al. (2019).

The quality and competence of the healthcare workforce play a pivotal role in delivering highquality care. Several studies have highlighted the importance of continuous education and professional development for healthcare providers in KSA according to Alageel et al. (2023). Continuous education programs, including workshops, conferences, and training sessions, contribute to improving clinical skills, knowledge, and adherence to evidence-based practices. Moreover, the Saudi Commission for Health Specialties (SCFHS) regulates the licensing and certification of healthcare professionals (HCPs), ensuring their competence and adherence to professional standards according to Homepage | Saudi Commission for Health Specialties (2023). Adopting health information technology (HIT) has emerged as a critical factor influencing healthcare provider quality in KSA. Implementing electronic health records (EHRs) and other HIT solutions can improve clinical decision-making, care coordination, and patient outcomes according to Alzghaibi and Hutchings (2022). HIT integration facilitates the timely exchange of patient



information among healthcare providers, reduces errors, and enhances communication, improving healthcare quality according to Alotaibi and Federico (2019).

Patient-centered care is an essential aspect of healthcare quality. KSA has recognized the significance of patient satisfaction and experiences in evaluating healthcare provider performance. Studies have highlighted the importance of effective communication, empathy, and cultural sensitivity in promoting patient-centered care according to Turner and Archer (2020). Additionally, efforts have been made to enhance patient satisfaction by reducing waiting times, improving access to care, and implementing patient feedback mechanisms according to Shen and Lee (2018).

The financial aspects of healthcare provision can impact the quality of healthcare providers. In KSA, healthcare services are predominantly financed through public sources, with the government heavily subsidizing healthcare costs according to Al-Hanawi et al. (2017). Adequate healthcare financing ensures the availability of necessary resources, including medical equipment, medications, and well-maintained facilities. Additionally, healthcare financing models impact healthcare provider remuneration, influencing motivation, job satisfaction, and retention according to Mosadeghrad (2018).

An Exploratory Study published in the International Journal of Health Policy and Management in 2014 aimed to explore the factors influencing healthcare service quality in Iran. The study used a mixed methods approach and collected data from 32 healthcare experts through semi-structured interviews and a focus group discussion. The study found several factors influencing healthcare service quality, including Leadership and management, human resources, HCPs training and development, healthcare infrastructure, patient-centeredness, and financial resources. The study also highlighted that the cultural and social context of the Iranian healthcare system also plays a significant role in shaping healthcare service quality according to Mosadeghrad (2018).

A systemic review was done across the MENA region to address the patient-centered care (PCC) concept from the HCP's perspective; The study used a comprehensive search strategy to identify relevant studies published between 2000 and 2019 according to Alkhaibari et al. (2023). The study found that while there is a growing awareness of the importance of PCC in the MENA region, the implementation of PCC still needs to be improved.

The study identified several barriers to implementing PCC in the region, including cultural norms and values, the lack of patient empowerment, and the dominant biomedical model of care.



From another aspect, a study aimed to review and compare countries' health systems in the Middle East and North Africa (MENA) region according to Mate et al. (2017). The study found that the MENA region faces several challenges in providing equitable and accessible healthcare, including inadequate healthcare financing, limited healthcare resources, and a shortage of healthcare workers. The study also identified disparities in healthcare access and outcomes across the region, with vulnerable and marginalized populations often receiving lower-quality care. The study found that many MENA countries have implemented health system reforms to improve healthcare access and quality, such as expanding healthcare coverage and investing in healthcare infrastructure. However, the implementation of these reforms has been limited by political instability, conflicts, and economic challenges in the region.

1.1. Objectives:

This review aims to explore the currently available evidence that assesses the quality of healthcare providers in KSA and identify the key factors influencing the performance of healthcare providers in KSA.

1.2. Methodology:

1.2.1. Study method:

In our research, we developed a comprehensive search strategy to identify relevant literature, utilizing academic databases (such as PubMed, Google Scholar, and Embase). The keywords and search terms related to the research question we used, such as "healthcare providers," "quality," "KSA," "factors," "performance," and any specific factors of interest (e.g., workforce, regulation, technology, financing). According to our study objectives, we structured the research question for this literature review: What is the current understanding of the quality of healthcare providers in KSA (SA) and the factors that impact their performance?

We Defined clear inclusion and exclusion criteria to select relevant studies, including studies published between 2010 and 2022 in KSA, written in English and focusing on the quality of healthcare providers and factors influencing their performance. Exclude studies that do not meet these criteria or are not directly relevant to the research question. Once then, we create a data extraction form or table to extract relevant information from the selected studies systematically. Extract details such as authors, publication year, study design, sample size, methodology, key findings, and factors identified to healthcare provider quality.



We then analyze the extracted data to identify common themes and patterns related to healthcare provider quality and the factors influencing their performance.

A critical appraisal was then conducted to evaluate the quality and credibility of the included studies. We considered factors such as study design, sample size, methodology, potential biases, and the strength of the evidence presented.

1.2.2. Search strategy:

In our review, we have identified the quality and factors influencing the healthcare system in KSA from both the patient's and the healthcare provider's perspectives; we have utilized open-access medical search engines, including "PubMed, Embase, ScienceDirect, and Google Scholar." The main search terms used in our research include "KSA" and/or "Healthcare" and/or "Patients" and/or "quality" and/or "factors."

1.2.3. Literature extraction:

A total of 43 studies were identified from PubMed, Embase, and Google Scholar search engines. A total of 35 were included for the title and abstract screening after removing 8 duplicates and irrelevant studies. Following the screening, 14 studies were excluded, and 21 studies underwent further review for the quality and factors influencing the healthcare system in KSA. A total of 6 studies were excluded following the review, and 15 were included for data extraction (Figure 1).

1.2.4. Inclusion and exclusion criteria

This study was limited to empirical research from January 2007 to December 2022. Only studies that were published in peer-reviewed journals were included. Also, only studies that were carried out in KSA were included. In addition, the selected literature included studies highlighting the factors attributing to quality of care in the healthcare system from patients, HCPs, nurses, and management.

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Figure 1 PRISMA for the selected literature

2. Results

2.1. Quality assessment:

Quality assessment for studies in a literature review involves evaluating the included studies' reliability, validity, and relevance. It aims to determine the trustworthiness of the research and the extent to which it contributes to the overall findings and conclusions of the literature review. The criteria used for quality assessment may vary depending on the research field and the review's objectives. The articles included in this study underwent quality assessment using the Joanna Briggs checklist, and the findings are summarized in **Error! Reference source not found.**.



Figure 2 Quality assessment of the assigned articles in literature



2.2. Quality and factors influencing the healthcare system globally:

An Exploratory Study published in the International Journal of Health Policy and Management in 2014 aimed to explore the factors influencing healthcare service quality in Iran. The study used a mixed methods approach and collected data from 32 healthcare experts through semi-structured interviews and a focus group discussion. The study found several factors influencing healthcare service quality, including Leadership and management, human resources, HCPs training and development, healthcare infrastructure, patient-centeredness, and financial resources. The study also highlighted that the cultural and social context of the Iranian healthcare system also plays a significant role in shaping healthcare service quality according to Mosadeghrad (2018).

A protocol-driven article published in 2020 in the Systematic reviews journal involving a comprehensive search of multiple databases for relevant systematic reviews published between 2000 and 2019, with a focus on studies conducted in high-income countries to identify the factors that affect patients' access to healthcare, including structural and organizational factors, financial barriers, sociodemographic factors, and cultural factors according to Dawkins et al. (2020).. The article highlighted the importance of understanding the factors that affect access to healthcare, given the significant impact that lack of access can have on health outcomes, health equity, and healthcare costs. The article suggested that the review's findings could inform the development of policies to improve patient access.

Another study aimed to assess the main factors impacting the healthcare system from patients' perspectives in Italy. The survey included questions about patients' demographics, their satisfaction with healthcare services, and their perceptions of the quality of healthcare. The study found that patients' perceptions of healthcare quality were primarily influenced by communication, empathy, and trust in healthcare providers according to Bellio and Buccoliero (2021).

Patients also identified the importance of the accessibility and availability of healthcare services and the cleanliness and comfort of healthcare facilities. The study also found that patients' perceptions of healthcare quality were positively associated with their overall satisfaction with healthcare services and their likelihood to recommend the healthcare provider to others. The study suggests that healthcare providers must prioritize effective communication, empathy, and trust-building with patients to improve patients' perceptions of healthcare quality according to Bellio and Buccoliero (2021).



2.3. Quality and factors influencing healthcare system in the Middle East region:

A study aimed to identify the factors influencing healthcare providers' care quality in Jordanian hospitals from the perspectives of nurses, pharmacists, and physicians. The study used a cross-sectional design and collected data from 384 healthcare providers through self-administered questionnaires. The study utilized a multi-stage sampling technique to select participants from different public and private hospitals in Jordan. The study found that healthcare providers' care quality was influenced by several factors, including organizational factors, such as management support, work environment, and resource availability, and individual factors, such as healthcare providers' knowledge, skills, and attitudes. The study also found that communication and teamwork were critical factors that impacted the quality of care provided by healthcare providers according to Algunmeeyn et al. (2021).

A systemic review was done across the MENA region to address the patient-centered care (PCC) concept from the HCP's perspective; the study used a comprehensive search strategy to identify relevant studies published between 2000 and 2019 according to Alkhaibari et al. (2023). The study found that while there is a growing awareness of the importance of PCC in the MENA region, the implementation of PCC still needs to be improved. The study identified several barriers to implementing PCC in the region, including cultural norms and values, the lack of patient empowerment, and the dominant biomedical model of care.

The study also found that healthcare providers in the MENA region have limited knowledge and skills in delivering PCC and that patient participation in decision-making still needs to be improved. However, the study also identified some positive factors that promote PCC, such as the use of technology to enhance patient engagement and the role of family members in supporting patients' needs according to Alkhaibari et al. (2023).

From another aspect, a study aimed to review and compare countries' health systems in the Middle East and North Africa (MENA) region. The study found that the MENA region faces several challenges in providing equitable and accessible healthcare, including inadequate healthcare financing, limited healthcare resources, and a shortage of healthcare workers. The study also identified disparities in healthcare access and outcomes across the region, with vulnerable and marginalized populations often receiving lower-quality care. The study found that many MENA countries have implemented health system reforms to improve healthcare access and quality, such as expanding healthcare coverage and investing in healthcare infrastructure.



However, the implementation of these reforms has been limited by political instability, conflicts, and economic challenges in the region according to Mate et al. (2017).

2.4. Patients' preference towards quality and factors attributing to healthcare in KSA

In our study, ten studies

Table **2** have highlighted several factors that attribute to impacting the quality of the healthcare system in KSA from patients' perspective; these factors were summarized into Infrastructure and devices available, Emotional, social, and physical support, Duration of clinical intervention, Experience of HCPs, Drug and appointment availability.



Figure 3 Factors shared by patients in KSA that impact the quality of the healthcare system

Infrastructure and devices availability

According to a study by Alqossayir et al. (2021) aimed to assess the factors associated with patients bypassing primary healthcare centers in Qassim Region, KSA, through a cross-sectional study among 266 patients in 2021, the main outcomes of this study emphasized that 31.7% believed that PHCs were insufficient for diagnostic tests, This study strongly recommends that facilities at PHCs should be improved by considering the factors identified by patients, including the hiring of experienced medical staff and improving diagnostic measurements.

Emotional, social, and physical support

The impact of emotional, social, and physical support as factors influencing the healthcare system is significant; it can Improve patient well-being, enhance patient engagement, and increase patient



satisfaction; this will positively impact HCPs and potentially lead to cost savings according to Al Shammrie et al. (2022). In our review, three studies have highlighted the impact of emotional, social, and physical factors as important factors that influence the quality of the healthcare system, according to a study by Alosaimi et al. (2022) aimed to analyze factors that Influencing Patient Selection of a Surgeon for Elective Surgery in KSA through a Questionnaire-Based Survey, in a cross-sectional study manner, 609 participants have participated in providing their inputs, 84.7% mentioned that paying attention to patient's needs and opinions is important; sparing enough time for patients is important as reported by 83.9% of the participants, and communication skills were considered to be important as stated by 82.6% of the participants.

In another study aimed to address patient's perspectives on factors affecting health-seeking behavior in Al-Ahsa, KSA, among 481 participants, socioeconomic factors contributed a lot to the frequency of visiting the healthcare system, 68.5% of participants with intermediate economic status visit healthcare centers for any symptoms compared to 50% of others with high financial status (P=.049) according to Almaqhawi et al. (2022). Lastly, according to a study by Al Shammrie et al. (2022) aimed at factors affecting patient satisfaction in dermatology clinics in KSA. in a cross-sectional study across 1002 patients, the main outcome was that emotional support and physical comfort appeared to be the most crucial factors in determining patient happiness.

Clinic duration time and appointment availability:

In a study aimed to assess how satisfied the Saudi people are with their public sector healthcare services by Al-Hanawi et al. (2017) among 36 participants in 2018 through a cross-sectional interview study, 50% of the participants reported dissatisfaction with the healthcare service provided by the PHCs, out of the dissatisfied patients, 94% reported that Waiting times in accessing public hospitals or unavailability of appointments were on top of the reasons of dissatisfaction, in addition also, 61% reported there dissatisfaction from the waiting time before seeing HCP. According to a study by Alqossayir et al. (2021), among 266 patients visiting the ER clinics, the outcomes show that more than half of the selected patients indicated that the opening times of the PHCs were inconvenient, as they used to visit emergency departments at public hospitals in the evening or during the night.

HCPs' Experience and Competencies

The skills, knowledge, and capabilities of the healthcare providers are highly influencing the quality of healthcare service; this can be related to how improvement in the provided quality and



emotional support to patients, providing personalized care for each patient, and providing better counseling for patients, from this aspect, many studies in our report have highlighted this pillar of HCPs knowledge as one of the main factors that impact the quality of healthcare system. A study by Alqossayir et al. (2021) has shown that among 266 participants, 38.1% mentioned a lack of experienced staff, as well approximately 42.2% of the unmarried participants suggested that more experienced staff at PHCs were urgently needed. From another aspect, Alosaimi et al. (2022) studied the attitude and factors impacting healthcare quality across 609 patients in KSA; 88.3% of patients thought it was crucial to research the doctor before contacting them for the current admission.

Specialists and drugs availability:

In a study by Al-Hanawi et al. (2017) across 36 participants aiming to address the factors influencing the quality of care across patients in KSA, as shared earlier, half of the patients reported dissatisfaction with the quality of the provided healthcare system, 22% have reported that lack of drug availability and 17% have reported absence of the specialists in the hospital as one of the driving dissatisfactions for the healthcare system. Lastly, in a study Alqossayir et al. (2021) in a cross-sectional study among 266 patients, 13.8% of the patients reported the unavailability of prescribed medicines.



Figure 4 Types of study for patients' preference factors for quality of healthcare system



2.5. HCPs and nurses' preference towards quality and factors attributing to healthcare in KSA

In KSA, HCPs and nurses strongly prefer quality healthcare services and recognize the factors that contribute to it. They prioritize delivering care that meets international standards and embraces evidence-based practices. HCPs in KSA emphasize the importance of continuous professional development to enhance their skills and knowledge. They value using advanced technologies and state-of-the-art medical equipment to provide accurate diagnoses and effective treatments. HCPs in KSA also emphasize the significance of patient-centeredness, respecting patients' cultural beliefs, values, and preferences and involving them in decision-making. In our review, five trials have highlighted the preference of HCPs and nurses towards the impact of healthcare management and information towards the quality of the healthcare system in KSA

Table *3*; these factors were summarized into healthcare management and information, hospital supervision & training, and development program to HCPs.



Figure 5 Factors shared by patients in KSA that impact the quality of the healthcare system

Healthcare management & information

In a cross-sectional study by Alatawi et al. (2022) among 20 physicians aiming to examine the factors that influence the efficiencies of health service provision in public hospitals in KSA and their potential remedies, ineffective management and lack of strategic planning were among the key factors associated with the poor healthcare system, another study by Almujadidi et al. (2022) among 17 physicians through a cross-sectional designing aimed to explore social determinants of health in an primary health care setting in KSA, the need for a multidisciplinary approach,



The disconnect between the primary care clinic and the outside community hinders referral of patients to local support agencies was among the main factors impacting the quality of healthcare system.

In another study by Aljadhey et al. (2014), which was conducted in 2016 among 65 physicians via interviewing them so as to understand the Challenges to and the future of medication safety in KSA, the main outcomes of this study have shown that communication gaps between healthcare institutions, limited use of important technologies such as computerized provider order entry were on top of the healthcare management issues that impact the quality of healthcare system in KSA.

Hospital supervision

A study by Almujadidi et al. (2022) aimed to explore the different variants that impair the quality of the healthcare system in KSA among 17 physicians; in this study, healthcare providers emphasized that the bias provided by the supervisors in treatment between colleagues was one of the main challenges in impairing quality of healthcare management, another study by Al Malki et al. (2017) among 144 physicians through a cross-sectional study aiming to explore the Health professional perspectives of patient safety issues in intensive care units in KSA, the main outcomes driven from the study has shown that Leadership, blame culture, workload/staffing issues and communication were the factors most frequently reported as hindering a positive safety culture.

In a study aimed at Identifying the Factors Influencing the Leadership Performance of Saudi's Healthcare Sector by Algarni (2018) among 29 physicians in a cross-sectional design, fairness and equality scored the highest factor among healthcare providers as an impacting factor in the healthcare system, The study suggested that the relations between leaders and their followers need to be under the official supervision of the highest tiers of management. Lastly, in a study of 585 nurses aimed to understand the quality of work life among primary health care nurses in the Jazan region, KSA Almalki et al. (2012), the main outcomes of the study emphasized that the management and supervision issues were of concern among nurses, majority of the nurses have disagreed on receiving proper supervision and fair management from the authorities, it ranges between 51.2% till 68.3%.

Training and development program to HCPs

A study by Almalki et al. (2012) across 585 nurses aimed to understand the quality of work life among primary health care nurses in the Jazan region, KSA. 72.4% and 71.1% disagreed with the support to attend continuing education/training programs and Career advancement opportunities



from the hospital management, respectively. According to a review article by Al Asmri et al. (2019) highlighted that lack of training among healthcare providers was one aspect that impairs the healthcare system's quality.

From another aspect, a study aimed to understand Leadership Skills and their associated factors among Pharmacy Students at Umm Al-Qura University, Makkah, KSA. Among 400 physicians, the main outcomes of this study have shown that training in both leadership skills and emotional intelligence leads to the development of highly qualified healthcare personnel according to Alaaddin et al. (2021).



Figure 6 Population of study for preference factors for quality of healthcare system



Figure 7 Types of study for preference factors for quality of healthcare system



3. Discussion

The quality of the healthcare system in KSA is influenced by various factors, as highlighted in the studies included in our systematic review. Infrastructure and device availability emerged as significant factor, with patients expressing concerns about the insufficiency of diagnostic tests at primary healthcare centers (PHCs). Recommendations include improving facilities at PHCs, hiring experienced medical staff, and enhancing diagnostic measurements. Additionally, emotional, social, and physical support was found to play a crucial role in influencing healthcare quality. Socioeconomic factors also impact the frequency of patients visiting healthcare centers. To improve patient satisfaction, providing emotional support and physical comfort is essential according to Ibrahim and Allebdi (2020).

In our study, Clinic duration time and appointment availability were identified as key factors influencing healthcare quality. Patients reported dissatisfaction with waiting times in accessing public hospitals and the unavailability of appointments, leading them to visit emergency departments or bypass primary healthcare centers. This outcome was in line with other studies; according to a study by Sampson et al. (2008) conducted in the United Kingdom examining the relationship between waiting times for primary care appointments and patient satisfaction. The study found that patients waiting longer for appointments reported lower satisfaction levels. Specifically, patients who waited more than two weeks for an appointment were significantly less satisfied than those who could get an appointment within a week. A study conducted in Canada by Ansell et al. (2017) assessed the impact of waiting times for specialist consultations on patient outcomes. The study found that longer wait times for specialist appointments were associated with delayed diagnosis and treatment, leading to poorer patient outcomes. Specifically, longer waits were associated with increased morbidity and mortality rates for certain conditions.

Factors such as paying attention to patients' needs and opinions, sparing enough time for patients, and effective communication skills were identified as important aspects of our study; this was also in line with in a systematic review, researchers analyzed studies on the impact of HCP communication skills on patient outcomes. The review found that effective communication between HCPs, and patients significantly improved patient satisfaction, adherence to treatment plans, and overall healthcare outcomes. Good communication skills, including active listening, empathy, and clear information delivery, were associated with better patient experiences and outcomes according to Kwame and Petrucka (2021).



In our study, Ensuring a competent and knowledgeable experience and competencies of HCPs were identified as significant contributors to healthcare quality. Similar outcomes were also identified in a study by Kaihlaniemi et al. (2023) that examined the relationship between nurse staffing and patient outcomes. The study found that hospitals with a higher proportion of nurses with a Bachelor of Science in Nursing (BSN) degree had lower mortality rates and better patient outcomes. The study also revealed that hospitals with better nurse work environments, including adequate staffing levels and supportive policies, had higher levels of patient satisfaction. Also, a study conducted in Australia by Rawlings et al. (2019) explored the impact of HCPs ' clinical experience on the quality of care in acute care settings. The study found that HCPs with more experience had lower rates of adverse events and medication errors. Experienced HCPs were better able to recognize and respond to complex clinical situations, improving patient safety and outcomes.

Specialists and drug availability were also important factors influencing KSA's healthcare quality. For specialist availability, our outcomes aligned with a systematic review by Pilonieta et al. (2023) who analyzed studies on the impact of specialist availability on healthcare quality and patient outcomes. The review found consistent evidence that increased availability of specialists was associated with improved healthcare quality, reduced hospitalizations, and better patient outcomes. Access to specialized care plays a crucial role in diagnosing and managing complex medical conditions effectively.

On the other hand, Drug availability and its impact on healthcare quality were also mentioned in a study conducted in the United States by Phuong et al. (2019) who investigated the impact of drug availability on healthcare outcomes. The study found that patients with barriers to accessing essential medications experienced poorer health outcomes and higher healthcare costs. Limited availability of certain drugs, such as those used for chronic conditions or rare diseases, significantly impacted patients' ability to manage their health.

4. Recommendations:

Improving the quality of the healthcare system in KSA presents various opportunities for enhancing patient care and outcomes. Here are some key opportunities that can contribute to the improvement of healthcare quality in KSA:

1. Investment in Healthcare Infrastructure: Increasing investments in healthcare infrastructure can significantly enhance the quality of healthcare services in KSA. This includes expanding



and improving facilities, upgrading medical equipment and technologies, and ensuring adequate resources for healthcare providers. By investing in modern Infrastructure, healthcare organizations can offer more efficient and effective treatments, diagnostic capabilities, and patient-centered care.

- 2. Strengthening Healthcare Workforce: Focusing on developing and training HCPs is crucial for improving healthcare quality. This involves continuous professional development programs, ensuring a competent and skilled workforce, and promoting a culture of lifelong learning. Encouraging healthcare providers to acquire advanced certifications, keeping up with the latest research and best practices, and fostering a culture of innovation can lead to improved patient outcomes and overall quality of care.
- 3. Enhancing Patient Engagement: Engaging patients in their healthcare journey can positively impact healthcare quality. By promoting shared decision-making, patient education, and communication, healthcare providers can empower patients to participate in their treatment plans and make informed choices actively. Emphasizing patient-centered care and considering patients' cultural beliefs, values, and preferences can foster a stronger patient-provider relationship, improving satisfaction and better health outcomes.
- 4. Strengthening Healthcare Regulation and Governance: Establishing a robust regulatory framework and governance structure is essential for ensuring consistent quality standards across healthcare facilities in KSA. Strengthening regulatory bodies, implementing accreditation programs, and enforcing adherence to quality standards can help identify areas for improvement and ensure that healthcare providers meet the required quality benchmarks. Regular audits, quality assessments, and monitoring systems can provide valuable feedback for continuous improvement.
- 5. Embracing Digital Health Technologies: Utilizing digital health technologies, such as electronic health records, telemedicine, and health information exchange systems, can enhance the efficiency, accessibility, and coordination of healthcare services. These technologies can streamline workflows, improve communication among healthcare providers, and enable remote consultations and monitoring. Embracing digital health solutions can improve care coordination and patient outcomes.



6. Collaboration and Research: Encouraging collaboration among healthcare providers, researchers, and policymakers is vital for driving quality improvement initiatives. Supporting and funding research studies on healthcare quality and outcomes can generate valuable insights and evidence-based practices. Collaborative efforts facilitate the exchange of knowledge, best practices, and innovative ideas.

5. Conclusion

In conclusion, several factors have been linked to impacting the quality of healthcare services in KSA. By considering these factors and addressing the challenges they present, policymakers and healthcare providers in KSA can work towards enhancing the quality of healthcare services. Improving infrastructure and device availability, ensuring emotional and physical support, addressing clinic duration and appointment availability issues, enhancing the experience and competencies of HCPS, and improving specialists and drug availability are essential steps. Furthermore, effective healthcare management and information systems, proper hospital supervision, and robust training and development programs for HCPs should be implemented to enhance healthcare quality in KSA.

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Appendices

Table 1 Quality assessment of the assigned articles in literature

	Is the	Were the	Was the	Were the	Were the	Were there
Authors	Review	Inclusion	Research	Sources	criteria for	Methods to
	Question	Criteria	Strategy	used to	Appraising	Minimize
	Clearly	Appropriate for	Appropriate?	Search	Studies	Errors in Data
	Stated?	the Review Q.?		Adequate?	Appropriate?	Extraction?
Al Shammrie et al.	Yes	Yes	Yes	Yes	Yes	Yes
(2022)						
Almaqhawi et al.	Vac	Vas	Vac	Unaloar	Vac	Vac
(2022)	105	Tes	168	Ulicical	105	108
Al-Hanawi et al.	Vas	Vas	Vac	Vac	Vac	Vac
(2017)	<i>17)</i>		105	105	105	105
Alosaimi et al.	Ves	Ves	Ves	Ves	Ves	Vec
(2022)	103	103	105	103	105	105
Alqossayir et al.	Ves	Ves	Ves	Unclear	Ves	Ves
(2021)	103	103	105	Chelear	100	100
Almalki et al.	Ves	Yes	Yes	No	Yes	Ves
(2012)	105					100
Ibrahim and	Ves	Yes	Yes	Yes	Yes	Vac
Allebdi (2020)	105					105



	Is the	Were the	Was the	Were the	Were the	Were there
Authors	Review	Inclusion	Research	Sources	criteria for	Methods to
	Question	Criteria	Strategy	used to	Appraising	Minimize
	Clearly	Appropriate for	Appropriate?	Search	Studies	Errors in Data
	Stated?	the Review Q.?		Adequate?	Appropriate?	Extraction?
Algarni (2018)	Yes	Yes	Yes	Yes	Yes	Yes
Alatawi et al.	Vac	Yes	Yes	Yes	Yes	Yes
(2022)	ies					
Al Malki et al.	Vec	Yes	Yes	Yes	Yes	Yes
(2017)	res					
Aljadhey et al.	Vac	Yes	Yes	Unclear	Yes	Yes
(2014)	105					
S. Alayed et al.	Vas	Yes	Yes	Yes	Yes	Yes
(2014)	105					
Alaaddin et al.	Vac	Yes	Yes	Unclear	Yes	Yes
(2021)	105					
Al Asmri et al.	Vac	Yes	Yes	Yes	Yes	Yes
(2019)	105					
Almujadidi et al.	Vac	Yes	Yes	Yes	Yes	Yes
(2022)	res					

Table 2 Summary of articles for patient's preference factors for quality of healthcare system

Author	Study title	No. of patients	Method	Outcomes	
Al Shammrie et al. (2022)	Factors Affecting			• Emotional support, and	
	Patient		Cross-	physical comfort appear to	
	Satisfaction in	1002 patients	sectional	be the most crucial factors	
	Dermatology		study	in determining patient	
	Clinics in KSA			happiness.	
Almaqhawi et al. (2022)	Patient's				
	Perspective on		Cross- sectional study	• 68.5% of participants with	
	Factors Affecting	191 matianta		status visit healthcare centers for any symptoms compared to 50% of others	
	Health-Seeking	481 patients			
	Behavior in Al-				
	Ahsa, KSA			with high financial status.	
	1				

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 considered to be important. 88.3% of patients thought in was crucial to research the doctor before contacting her or him for the current admission 31.7% believed that PHCs 	it. 2 it 2
• 88.3% of patients thought in was crucial to research the doctor before contacting her or him for the current admission • 31.7% believed that PHCs	: it e
was crucial to research the doctor before contacting her or him for the current admission • 31.7% believed that PHCs	e S
doctor before contacting her or him for the current admission • 31.7% believed that PHCs	5
her or him for the current admission • 31.7% believed that PHCs	5
admission • 31.7% believed that PHCs	3
• 31.7% believed that PHCs	S
were insufficient for	
diagnostic tests.	
• more than half of the	
selected patients indicated	1
Factors associated that the opening times of	
with patients the PHCs were	
bypassing Cross- inconvenient.	
<i>Alqossayir el</i> primary 266 patients sectional • 38.1% mentioned a lack of	f
<i>al.</i> (2021) healthcare centres study experienced staff	
in Qassim •42.2% of the unmarried	
Region, KSA participants suggested that	t
more experienced staff at	
PHCs were urgently needed	ed
• 13.8% of the patients	
reported the unavailability	1
of prescribed medicines	

Fable 3 Summary of articles for HCPs-nurses	preference factors for	quality of healthcare	system
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Author	Study title	No. of patients	Method	Outcomes
Almalki et al. (2012)	Quality of work			• 51.2% till 68.3%. of the nurses
	life among		cross-	has disagreed on receiving
	primary health	585 nurse	sectional	proper supervision and fair
	care nurses in the		study	management from the
	Jazan region,			authorities.

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	KSA: a cross-			• 72.4% have disagreed on the
	sectional			support to attend continuing
				education programs
				• 71.1% have disagree on the
				career advancement
				opportunities from the hospital
				management
	Level and			
	determinants of			• Financial incentives impose a
	job satisfaction			negative impact on job
Ibrahim	among Saudi		cross	satisfaction for primary care
and	physicians	110 physician	cross-	physicians. On the other side, the
Allebdi	working in	119 physician	study	nature of work has had the most
(2020)	primary health-			positive impact on job
	care facilities in			satisfaction. Specialists have less
	Western Region,			satisfaction
	KSA			
	Identifying			
	Factors	29 physician	cross- sectional study	• 'fairness and equality, islamic
Algarni (2018)	Influencing the			value, The study suggested that
	Leadership			the relations between leaders and
	Performance of			their followers need to be under
	Saudi's			the official supervision of the
	Healthcare			highest tiers of management.
	Sector			
	Factors			• Ineffective hospital management,
	Influencing the		cross-	lack of strategic planning and
Alatawi et al. (2022)	Efficiency of			goals, weak administrative
	Public Hospitals	20 physician	sectional	leadership, and absence of
	in KSA: A		study	monitoring hospital performance
	Qualitative Study			was noted to have a profound
	Exploring			impact on hospital efficiency.

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Al Malki et al. (2017)	Stakeholders' Perspectives and Suggestions for Improvement Health professional perspectives of patient safety issues in ICU in KSA	144 physician	cross- sectional study	• Leadership,blame culture,workload issues and communication were the factors frequently reported as hindering a positive culture
Aljadhey et al. (2014)	Challenges to and the future of medication safety in KSA: A qualitative study	65 healthcare provider	Interview study	• communication gaps between healthcare institutions, limited use of important technologies such as computerized provider order entry
S. Alayed et al. (2014)	KSAn ICU safety culture and nurses' attitudes	216 nurse	cross- sectional study	 nurses were uncomfortable speaking openly about their concerns if they perceived a problem with patient care. Nurses' management perceptions received the lowest mean score and the overall lowest positive attitudes
Alaaddin et al. (2021)	Leadership Skills and their Associated Factors among Pharmacy Students at Umm Al-Qura University, Makkah, KSA.	400 physicain	cross- sectional study	• Training in both leadership skills and emotional intelligence leads to the development of highly qualified healthcare personnel.

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Al Asmri et al. (2019)	The public health care system and primary care services in KSA: a system in transition		Narrative review	• Shortage of health care professionals , training , lack of referral system. Besides the huge growth in NCDs
Almujadidi et al. (2022)	Exploring social determinants of health in a KSAn primary health care setting: the need for a multidisciplinary approach	17 physician	cross- sectional study	 Lack of physician knowledge or training, -Time constraints and difficulties to follow up, - Disconnect between the primary care clinic and the outside community hinders referral of patients to local support agencies, and bias

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