The Role of Healthcare Big Data in Healthcare Management Companies Supporting the Sustainable Development Strategy of Egypt Vision 2030: An Exploratory Study

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Abstract:

Egypt's Vision 2030 aims to provide distinguished health services. One of the ways to achieve this goal is to implement the health insurance law, unify insurance vessels, improve governance of the health sector and restructure it, in addition to improving infrastructure and activating digital transformation to ensure the existence of a unified health information system. Therefore, The study aimed to explore the readiness of healthcare management companies to integrate and share their big health data in framework of digital transformation to support Egypt's sustainable development strategy and achieve Egypt's Vision 2030, using the multiple case study method, where standardized 71-item checklist were relied upon as tools for collecting data. The study showed several results, most notably the lack of any coordination between healthcare management companies and government agencies responsible for healthcare. This is despite the readiness of healthcare management companies to govern their data and implement digital transformation. All healthcare management companies have big health data and demonstrate high data quality, with predictive capabilities at 72%. Reports generated from data analysis achieved 75% in addition to data integration and sharing by 87.5% and data security and privacy by 93%.

Keywords: Big data; health data; healthcare management companies; insurance companies; health insurance; sustainable development; Egypt Vision 2030.

Introduction

The concept of big data gained momentum in the early 2000s when Doug Laney characterized big data using the "3V's" volume, velocity, and variety (Laney 2001). According to this definition, "big data" refers to a large amount of data that is growing rapidly and is difficult or even impossible to handle using traditional methods (Oliveira and Bollen 2023).

IBM emphasizes that the main difference between big data analytics and traditional data analytics is the type of data being handled and the tools used to analyze it. Traditional analytics deals with structured data, which is typically stored in relational databases. This type of database helps ensure that the data is well-organized and easy for computers to understand. Traditional data analytics relies on statistical methods and tools such as Structured Query Language (SQL) to query databases. In contrast, big data analytics involves massive amounts of data in different formats, including structured, semi-structured, and unstructured data (Perry 2017).

The complexity of this data requires more sophisticated analysis techniques. Big data analytics uses advanced techniques, such as machine learning and data mining, to extract information from complex data sets (Mucci and Stryker 2024) .

The concepts of big data differed between 3V, 4V, and 5V, there are those who confirmed that the most common way to define big data today is through the "4V" (Oliveira and Bollen 2023):

- **Volume**: refers to the amount, size, and scale of data. The amount of data reaches a level that cannot be managed without dedicated analytical tools. Volume can be defined either vertically by the number of samples in a dataset or horizontally by the number of features.

- **Velocity**: refers to the speed at which data is generated and how quickly it can be processed.

- **Variety**: refers to the heterogeneity of data. Big data often comes from different sources, which can be diverse in type, form, semantics, and size.

- **Veracity**: refers to the quality of the data collected. The reliability and accuracy of data are of paramount importance, as decisions based on inaccurate or incomplete data can lead to negative outcomes. Veracity refers to the reliability of data, and the accuracy of any analytical process applied to data depends largely on the veracity of the source data.

While IBM define big data according to the "5V", it adds the "Value" element (Mucci and Stryker 2024). This element indicates that the goal of big data analytics is to extract actionable insights that provide tangible value. This includes transforming large data sets into useful information that can guide strategic decisions, discover new opportunities, and drive innovation. The researcher adopts the "5V" concepts, as the value element is one of the important elements in providing tangible values for big data.

Big data is now the gold standard of the new technological era, especially for organizations that handle large amounts of data daily, such as in the healthcare sector (Alhajaj and Moonesar 2023). Big data technology is characterized by volume, variety, speed, veracity, and value. It supports a wide range of healthcare functions, including clinical decision support, population health management, and disease surveillance.

By discovering correlations between data and understanding patterns and trends, big data technology can improve healthcare, save lives, reduce healthcare costs, and identify the most cost-effective treatment options in terms of clinical outcomes. (Wu, et al. 2022).

It is worth noting that the International Telecommunication Union (ITU) recommended digitizing and anonymizing clinical data sets by establishing appropriate digital infrastructure, electronic health records, and secure data exchange practices among different healthcare providers. Additionally, it emphasized creating conditions for public-private partnerships to use and exchange clinical data through data trusts/secure data pools, making clinical data interoperable, and creating a clear framework for the use and exchange of clinical data (Stankovic, Garba and Neftenov 2021).

It is clear from the above that health data is a form of "big data" not only because of its enormous volume, but also because of its complexity, variety and timing. Although a large volume of structured data is already available today, the volume of unstructured data, such as biometric data, text reports and medical images, will affect the volume of data. This is closely related to the challenge of dealing with the great diversity of health data. Heterogeneous data, such as images, structured reports, unstructured notes, not only require new forms of (pre)processing but also must reflect the semantics of their different domains, such as financial, administrative, research, patient health, or public health (Zillner and Neururer 2016).

One of the most important benefits of big data analysis of healthcare records is the ability to examine individual characteristics of clients along with their expected financial costs and subsequent health needs. This can lead to the provision of the best treatment methods, and their cost forecasts. Furthermore, preventive and predictive methods can be combined, supported by wide-ranging input variables.

Another potential that big data analysis offers to providers is the sharing of key information across multiple organizations, enhancing time savings and understanding of patient needs (Hassani, Unger and Beneki 2020). In addition to the many other advantages of big data analysis in the context of public health, medical services development, genetic mapping analysis, and remote device monitoring (Raghupathi and Raghupathi 2014).

This was reinforced by (Belle, et al. 2015), who highlighted that big data analysis can also help improve individual health progress and the shift towards personalized medicine, in addition to predicting personal health and improving physician decisions. It can also help clinical trials by selecting the right participants, making the process less expensive, and providing more insights into drug safety, as well as early detection and tracking of harmful drug side effects.

Big data analysis can also help in monitoring infectious disease trends and tracking cases within populations, which can help in making the right decision and acting immediately to reduce the spread of infectious diseases (Alhajaj and Moonesar 2023).

Most developed countries have realized the importance of big data and have shown interest in improving the healthcare system by collecting and analyzing such data (Alhajaj and Moonesar 2023). In 2009, the US Congress passed the Health Information Technology for Economic and Clinical Health (HITECH) Act (OCR 2017), which aims

to promote and expand the use of health information technology and reliance on electronic health records by all healthcare providers. The law imposes strict penalties for non-compliance and offers additional incentives to healthcare institutions and their partners for better adherence.

The UAE has also adopted the HITECH law, making electronic medical records mandatory across healthcare authorities in both the public and private sectors (Alhajaj and Moonesar 2023)**.**

Big data is a source of information for insurance companies. Actuarial science and insurance are global industries that attract twice the revenue of the oil industry. Therefore, the concentrated use of big data is worth analyzing and studying. In 2018, the global insurance sector generated revenues of more than $ 5 trillion —a figure that exceeds the GDP of the world's major economies such as Japan, Germany, the United Kingdom, India, Italy, France and Canada, and is double the revenue of the oil industry.

Insurance experts working in healthcare sectors can deal with many sources of big data that were previously unavailable. The data banks are no longer limited to demographic data and healthcare services but also have the ability to map a patient's genetic profile (Hassani, Unger and Beneki 2020). Health insurance is crucial to promoting universal health coverage, one of the components of the Sustainable Development Goals. Different countries have developed different insurance scheme models based on their social and economic conditions.

In 2016, the State Council of China issued the Directive on Promoting and Standardizing the Application and Development of Big Data in Healthcare. This directive included the healthcare-generated data in the strategic planning for the development of big data, especially insurance data in the healthcare field. It also allowed the use of information systems to exchange big data in the healthcare sector (Lv and Qiao 2020).

Healthcare management companies manage the relationship between insurance companies, medical service providers, and insured people. They are the entity responsible for following up on patient files in hospitals, pharmacies, analysis and radiology centers, and verifying the accuracy of the expenses charged to the patient. They regulate the relationship in a neutral manner between the insurance company (which guarantees a specific health insurance policy), the insured persons, and medical service providers, ensuring compliance with the terms of the insurance policy issued by the insurance company. They also regulate contracts with medical service providers, including hospitals, clinics, pharmacies, and radiology and analysis centers.

This role requires the exchange of big healthcare data, and the establishment of strong communication links between private insurance companies and medical service providers. By leveraging big healthcare data, private insurance companies or healthcare management companies can evaluate and provide feedback on changes in the behavior of medical service providers. They can also control medical expenses without compromising appropriate diagnosis and treatment (Wu, et al. 2022), as illustrated in (figure1)

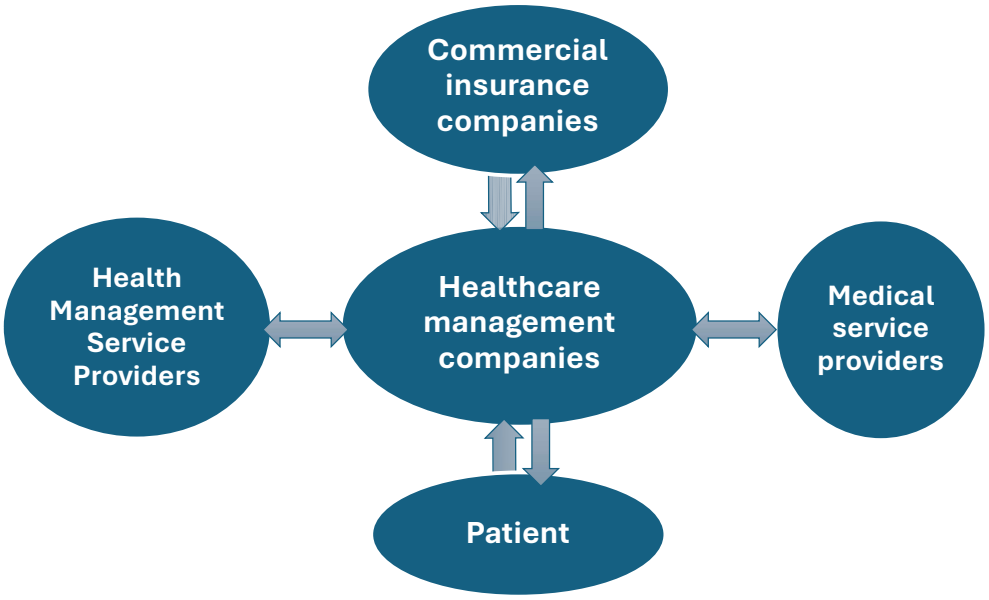


Figure 1 The operating pattern of insurance companies for health insurance policies.

Health insurance is crucial for promoting universal health coverage, which is one of the components of the Sustainable Development Goals. Different countries have developed different insurance scheme models based on their social and economic conditions. In 2016, the State Council of China issued the Directive on Promoting and Standardizing the Application and Development of Big Data in Healthcare. This directive incorporated healthcare-generated data in the healthcare sector in the strategic planning for the development of big data, especially insurance data in the healthcare field, allowing the information systems used to exchange big data in the healthcare sector (Lv and Qiao 2020).

However, the healthcare industry has not fully realized the potential benefits of big data analytics. Although academic studies in the field of data analytics are growing significantly, they focus only on the technological aspect, ignoring the impact of big data analytics on the healthcare industry (Wang, Kung and Byrd 2018). Moreover, usability studies have not considered quantitative research but rather qualitative methods that identify the potential benefits. Moreover, most studies have been conducted in developed countries, highlighting the need to expand the scope of big data analytics research in developing countries (Mehtaa and Panditb 2018).

As Egypt's Vision 2030 aims to provide distinguished health services, The National Agenda for Sustainable Development (Development 2023) stated that one of the ways to achieve this goal is by implementing the health insurance law, unifying insurance vessels, improving governance and restructuring the health sector, as well as improving infrastructure and activating digital transformation to establish a unified health information system.

Therefore, this study seeks to monitor and explore the readiness of private health insurance companies to govern their big health data and support the achievement of Egypt's Vision 2030 in providing distinguished health services.

The importance of the study lies in the numerous benefits that big health data can provide to private insurance companies. These benefits are based on the insights that can be obtained directly by providing distinguished health services. This starts with the governance of that data, enhancing cooperation, and improving the infrastructure of the health system, education, and population health. It also involves developing clinical needs and related health services, including radiology devices, laboratories, early detection and prevention of diseases, in addition to the pharmaceutical industry.

The greatest impact of big data applications in healthcare is expected when it becomes possible to rely on different data sources, allowing the integration of all relevant health data, such as clinical data, claims, cost and management data, pharmaceutical and research data, and patient monitoring data (Zillner and Neururer 2016). This data is available in healthcare management companies authorized by Egyptian private health insurance companies, which can analyze their big health data to directly contribute to achieving Egypt's Vision 2030 for distinguished health services. Accordingly, advances in information technology and big data analytics, if applied appropriately, will significantly improve healthcare systems and health insurance policies, thereby achieving the sustainable development goals in the health sector.

Study objective:

The main purpose of this study is to explore the readiness of big health data for healthcare management companies to integrate and share their big health data in framework of digital transformation to support the sustainable development strategy and achieve Egypt's Vision 2030.

Literature review:

Hajjaj and Monesar reported on systematic reviews of big data usage, assessing experiences in healthcare systems and related issues in the United Arab Emirates using the PRISMA systematic review method. The reviews showed that healthcare systems in the United Arab Emirates could be improved through big data by integrating it with health information systems, supported by IT professionals, healthcare managers, and stakeholders. Data privacy, data storage, data architecture, data ownership, and governance were identified among the most common concerns (Alhajaj and Moonesar 2023).

Batko and Ślęzak aimed to explore the potential use of big data analytics in healthcare through a critical review of the literature, along with an analysis of direct research on its application in medical facilities. The direct research was conducted using a questionnaire and involved a sample of 217 medical facilities across Poland. The literature review revealed that big data analytics can offer numerous benefits to medical facilities. The direct research findings further confirmed this, showing that Polish medical facilities are progressing towards data-driven healthcare. They utilize both structured and unstructured data and apply analytics across various domains, including administration, business, and clinical areas. The study also highlighted that medical facilities are actively working with both types of data, aligning with the findings in the

literature that medical institutions are transitioning to a data-based healthcare model, with all the associated advantages (Batko and Ślęzak 2022).

On the other hand, Wu and colleagues evaluated the big healthcare data in commercial health insurance companies in China. They identified potential approaches to secure big healthcare data, identified the shortcomings of current big healthcare data in commercial health insurance, and evaluated the obstacles and risks in its implementation. They found that the degree of informatization of the healthcare industry in China is still limited. They recommended improving the performance of commercial health insurance companies, their products and services, and government reforms in the field of big healthcare data, such as expanding cooperation in the medical industry, further developing big healthcare data application processes, increasing data sharing, addressing privacy risks, establishing data standards, and improving data quality (Wu, et al. 2022).

While Hassani and colleagues emphasized that big data can be used in actuarial fields with future applications, they addressed its use in auto insurance, mortality modeling, healthcare, harvest risks, and cyber risks; disaster risks such as storms, hurricanes, tornadoes, geomagnetic events, earthquakes, floods, and fires; and climate risks in general. This approach improves the accuracy of forecasts and, thus, the pricing of insurance premiums (Hassani, Unger and Beneki 2020).

Kumar and Singh explored the significant impact of big data on healthcare, focusing on the various tools available within Hadoop to manage and process healthcare data. They delved into the conceptual architecture of big data analytics in healthcare, emphasizing the integration of data from multiple sources, such as historical data from different medical disciplines, genomic databases, electronic health records (EHR), text/images, and clinical decision support systems (CDSS). They highlighted the potential of combining big data with healthcare analytics to revolutionize patient care. By leveraging these technologies, healthcare professionals can more accurately prescribe medications tailored to the specific needs of individuals, improving treatment outcomes. The discussion underscored the importance of advancing research in this field to address the challenges currently facing the healthcare system. They concluded that extensive research will be essential to overcome these obstacles and fully realize the potential of big data in healthcare (Kumar and Singh 2019). On the other hand, Ali showed in his study that there is an individual trend on some private hospitals in Egypt are beginning to adopt big data technologies. He also pointed out the Egyptian healthcare sector is suitable for implementing these technologies with amendments to policies and regulations (Ali 2018).

Mehta and Pandit divided the scope of big data analytics in healthcare by analyzing a systematic literature review of 58 articles into five main areas. They found that researchers lack consensus on a practical definition of big data in healthcare. Big data in healthcare comes from internal sources, such as hospitals or clinics, as well as external sources, such as pharmaceutical companies and governments. Natural Language Processing (NLP) is the most widely used technology in healthcare, and most of the processing tools used for analytics are Hadoop-based. They also highlighted that big data analytics improves clinical decision support and reduces the cost of care. However, the main challenge in adopting big data analytics is the lack of evidence regarding its practical benefits in healthcare (Mehtaa and Panditb 2018).

Ristevski and Chen highlight the promising role of big data analytics in the fields of medicine and healthcare. They emphasize its potential in integrating, exploring, and analyzing vast amounts of complex, heterogeneous data from various sources, including biomedical data, experimental data, electronic health records, and social media. The integration of such diverse types of data creates a dynamic relationship between big data analytics and several fields, such as bioinformatics, medical imaging, sensor information, medical informatics, health informatics, and computational biomedicine. Furthermore, the characteristics of big data provide a solid foundation for the developing innovative software platforms. These platforms can be used to create applications capable of effectively managing and processing big data in medicine and healthcare, offering significant potential for future advancements. (Ristevski and Chen 2018).

Wang and colleagues identified five key elements for achieving valuable results when analyzing big data in healthcare: care pattern analysis, unstructured data analysis, decision support, prediction, and traceability. They combined these elements using a content analysis approach of 26 studies on big data in healthcare. (Wang, Kung and Byrd 2018). Gupta and Tripathi point out that big data analytics can be beneficial to the state of primary health care for people in remote rural areas of India by enabling informed decision-making and gaining insights from the analysis of clinical data repositories (Gupta and Tripathi 2016).

The literature review studies the importance of analyzing big health data for insurance companies and healthcare management companies, and its significant role in developing the healthcare sector. In addition, governments such as those of the United Arab Emirates, China, and India have shown interest in analyzing healthcare big data to serve their healthcare sectors.

Scope of study:

The study focuses on exploring the current state of healthcare big data management in Egyptian healthcare management companies that have been authorized by Egyptian insurance companies recognized by the government. These companies must have financially profitable medical documents for the year 2022-2023 in the Arab Republic of Egypt. The data was collected between August 11, 2024, and October 21, 2024.

Methodology

Study Design and Data Collection

A multiple-case studies approach was used in this study, as it is the most suitable method for analyzing data for different cases and understanding the similarities and differences between them. Given the absence of an official body responsible for these healthcare management companies in Egypt and the no official inventory of their number or activity until the date of this study*, the annual statistical book on insurance activity for the fiscal year 2022-2023, issued by the Financial Regulatory Authority

* According to Unified Insurance Law No. 155 of 2024, the Financial Regulatory Authority has given companies a full year to regularize their status, with the possibility of extending this period for other periods up to a maximum of three years.

(Authority 2024)**,** was relied upon to identify the Egyptian insurance companies that are well-known and recognized by the Egyptian government and operating in the private health insurance sector. Out of 42 insurance companies, 28 with financial activity related to health insurance were identified. Upon review of these companies, it was found that the operating model of insurance companies in the health insurance sector primarily involves paying healthcare costs after services are provided, relying on external companies to process their claims. These external companies, known as Third-Party Administrator (TPAs), handle the claims. Due to the importance of the services and data provided by these healthcare management companies, the House of Representatives has allocated Articles 31, 32, 33, and 34 of Unified Insurance Law No. 155 of 2024 to regulate medical insurance and related services According to the law, no company may engage in healthcare management activities without obtaining a license from the Financial Regulatory Authority and being registered in a specialized register. Healthcare management companies, as defined by the law, are responsible for all administrative work related to medical insurance policies issued by insurance companies, acting as a third party between the insurance company and the customer (Republic 2024). The researcher asked the insurance companies operating in the health insurance sector to list the health care management companies they deal with. In total, 23 out of 28 companies responded. authorizing 8 healthcare management companies (TPA) to handle their health insurance policies. It is worth noting that an insurance company may authorize more than one healthcare management company to manage its health insurance policies, as illustrated in (figure2)

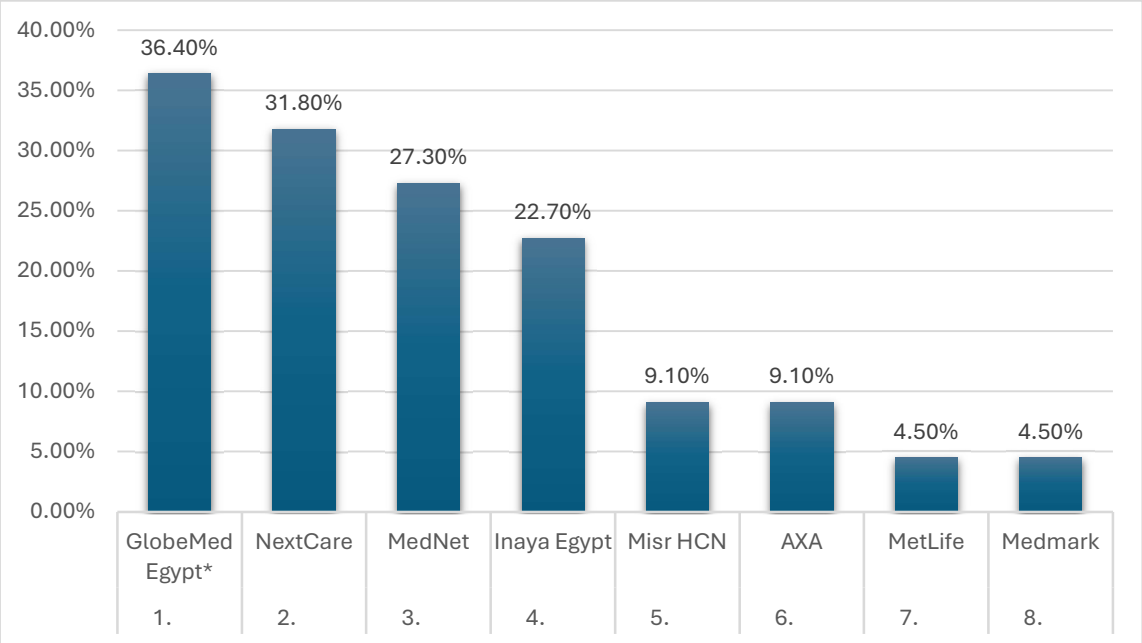


Figure 2 Percentage of each TPA company contribution in the total insurance companies

GlobeMed and MetLife declined to participate in the study, resulting in a study population consisting of six healthcare management companies.

Checklist

This study is based on a checklist method for collecting data on the study population. The checklist (Appendix 1) was used as a tool to explore the status of healthcare big data in the healthcare management companies under study. Its design was based on the General Authority for Healthcare Accreditation and Regulation's guide, Information Technology Management Chapter (GAHAR 2021), along with several studies addressing the technical requirements for applying big data analytics in the healthcare (Wu, et al. 2022) (Berthelé 2018) (Wang, Kung and Byrd 2018) (Zillner and Neururer 2016) (Research 2016).

The checklist consisted of 6 main items, from which sub-items emerged as follows:

Table 1 Checklist Items

Nu	Main Items	Items
1.	Main data	6
2.	Quality of Data	23
3.	Predictive Capabilities	3
4.	Reporting	28
5.	Data Integration, Sharing, and Backups	4
6.	Data Security and Privacy	7

The check list was examined and validated in terms of content and importance by three* experts in the field of health insurance.

Results

Main Data for Healthcare Management Companies

NextCare ranked first in terms of the volume of big health data and the number of patients in the system, followed by AXA and then Misr HCN. MedMark ranked second to last, followed by Inaya Egypt. MedNet did not specify the exact volume of its data, indicating that it exceeds one terabyte, and also refrained from specifying the total number of patients on the system. All companies had complete patient data on the company's system, except for AXA, which had 10,000 patients with incomplete data.

* Prof. Dr. Ahmed Hussein Al-Masry: Assistant Professor of Libraries and Information, Faculty of Arts, Helwan University. Dr. Amer Abdel Baqi, Head of the Medical Insurance Sector, Tharwa Insurance Company, Dr. Hesham Abdel Hakim Radwan, Head of the Medical Insurance Sector, Al Mohandes Insurance Company, and Dr. Dina Gamil, Head of the Operations Sector, Lebanese Swiss Takaful Insurance Company

Table 2 Main Data for Healthcare Management Companies

Company	Data volume	Total number of patients on the system	Total number of patients with complete data
AXA	4 TB	400000	300000
Inaya Egypt	1 TB	200000	200000
Misr HCN	3 TB	300000	300000
Medmark	1.5 TB	-	All patients completed their data.
MedNet	Over a terabyte	-	All patients completed their data.
NextCare	100 TB	510000	510000

Coordination between healthcare management companies and Egyptian government healthcare agencies

There was no coordination, data exchange, or cooperation between any healthcare management companies and the General Authority for Healthcare Accreditation and Regulation, the Ministry of Health, the General Authority for Health Insurance, or the Health Care Authority.

Quality of Data

Inaya Egypt, Misr HCN, AXA, and MedNet committed to recording the patient's full demographic data, including name, age, address, and job, NextCare and MedNet, however, only recorded name and age. All companies used only one identifier for each patient, which is a code specific to the company's system. The systems of Inaya Egypt, Misr HCN, and MedMark allowed the diagnosis of the patient's condition, medications, tests, and required radiology test through natural language input. These companies, along with MedNet, also allowed the integration of natural language with dropdown menus when necessary.

In contrast, NextCare and AXA prohibited natural language input for diagnostics or treatment procedures. Relying solely on dropdown selections from the International Classification of Diseases (ICD) and the Medical Coding System for Describing Medical Procedures and Services (CPT). Additionally, MedNet and AXA do not record the results of patient examinations (tests and radiology), unlike other companies.

No percentage was specified for the total of this standard because the fulfillment or absence of some criteria, such as the use of natural language, was not considered an advantage.

Table 3 Quality of Healthcare Management Companies Data

Standard	AXA	Inaya Egypt	Misr HCN	Medmark	MedNet	NextCare	Percentage
Complete demographic data	√	√	√	√	x	x	67%
Use unique ID for each patient	√	√	√	√	√	√	100%
Each patient has only one identifier, ensuring that there are no two identifiers for the same patient	√	√	√	√	√	√	100%
All entries are dated and clearly identified with the name and position of the person who wrote them.	√	√	√	√	√	√	100%
Report is written in natural language	x	√	√	√	x	x	50%
Report is entered by the ICD drop -down menus	√	√	√	√	√	√	100%
Diagnosis can be combined with the choice between ICD and adding a natural language explanation of the condition if necessary	x	√	√	√	√	x	67%
Medications required are entered via natural language.	x	√	√	√	x	x	50%
Medicines are selected from drop-down menus.	√	√	√	√	√	√	100%
When writing the	x	x	√	√	√	x	50%

Standard	AXA	Inaya Egypt	Misr HCN	Medmark	MedNet	NextCare	Percentage
medication, can choose from drop down menus and explain the condition in natural language if necessary.							
Medication is indicated if it is chronic or non-chronic.	√	√	√	√	√	√	**100%**
Duration of treatment is entered .	√	√	√	√	√	√	**100%**
Type of disease is selected for the prescribed ICD medications.	√	√	√	√	√	√	**100%**
Tests required are entered in natural language.	x	x	√	√	x	x	**33%**
Tests are selected by selecting the CPT dropdown menus	√	√	√	√	√	√	**100%**
When writing the Tests, can choose from drop down menus and explain the condition in natural language if necessary.	x	x	√	√	√	x	**50%**
Type of disease is selected for the tests described by ICD dropdown menus.	√	√	√	√	√	√	**100%**
Record test results for patients.	x	√	√	√	x	√	**67%**
The required radiology test results are written in natural	√	x	√	√	x	x	**50%**

Standard	AXA	Inaya Egypt	Misr HCN	Medmark	MedNet	NextCare	Percentage
language.							
Radiology tests are selected from the CPT drop -down menus.	√	√	√	√	√	√	**100%**
When writing the radiology test, can choose from drop down menus and explain the condition in natural language if necessary.	x	x	√	√	√	x	**50%**
Type of disease is selected for the prescribed radiology tests from ICD drop down menus .	√	√	√	√	√	√	**100%**
Record radiology tests result for patients	x	√	√	√	x	√	**67%**

Predictive Capabilities

The healthcare management companies' big data achieved 72% of the predictive capabilities, with NextCare, MedNet, and Inaya Egypt fully implementing 100% of all big data analysis predictive capabilities. AXA managed to generate usage indicators after data collection that could be predictive and provide insights into high-risk patients, achieving only 33%. MedMark came in last place, unable to provide any predictive capabilities from the data collected.

Table 4 Predictive capabilities of healthcare management companies

Standard	AXA	Inaya Egypt	Misr HCN	Medmark	MedNet	NextCare	Percentage
Generate usage indicators can predict and provide insights into high-risk patients.	√	√	√	x	√	√	**%83**
Predicts future expenses and calculates the probability of one or more hospital	x	√	√	x	√	√	**%67**

Standard	AXA	Inaya Egypt	Misr HCN	Medmark	MedNet	NextCare	Percentage
admissions.							
Provide classified indicators for future usage to support healthcare, manage medical conditions and support insurance experts.	x	√	√	x	√	√	**%67**
Total	**%33**	**%100**	**%100**	**%0**	**%100**	**%100**	

Reports

Regarding reports, the big health data of the healthcare management companies under study achieved 75% of the reports based on their data analysis. Medark provided only six reports out of 28 expected from big health data analysis, achieving just 21%. MedNet and AXA were equal at 79%, while NextCare approached them at 82%. Inaya Egypt advanced with 89% of the standards, occupying second place after Misr HCN, which fully exploited all data and achieved 100%, maintaining its lead among healthcare management companies in the optimal exploitation of big health data analysis.

Table 5 Reports on healthcare management companies

Standard	AXA	Inaya Egypt	Misr HCN	Medmark	MedNet	NextCare	Percentage
Types of diseases covered	√	√	√	√	x	√	**83%**
Financial cost generally, according to disease types in a specific period (previous, subsequent)	√	√	√	√	x	√	**83%**
Financial cost generally, according to test types in specific period (previous, subsequent)	√	√	√	√	x	√	**83%**

Standard	AXA	Inaya Egypt	Misr HCN	Medmark	MedNet	NextCare	Percentage
Financial cost generally, according to Radiology test types in a specific period (previous, subsequent)	√	√	√	√	x	√	**83%**
Reports on the relationship between age and diseases.	√	√	√	√	x	√	**83%**
Reports on the relationship between gender and diseases.	√	√	√	√	x	√	**83%**
Reports on the relationship between jobs and diseases.	x	√	√	x	x	x	**33%**
Reports on the relationship between Residential area and diseases.	x	x	√	x	x	x	**17%**
Most types of diseases in a specific period.	√	√	√	√	x	√	**83%**
Most types of medications in a specific period.	√	√	√	√	x	√	**83%**
Most types of tests in a specific period.	√	√	√	√	x	√	**83%**
Most types of radiology tests in a specific period.	√	√	√	√	x	√	**83%**
Reports on the relationship between age and tests.	√	√	√	√	x	√	**83%**
Reports on the relationship between gender and tests.	√	√	√	√	x	√	**83%**
Reports on the	x	√	√	x	x	x	**33%**

Standard	AXA	Inaya Egypt	Misr HCN	Medmark	MedNet	NextCare	Percentage
relationship between job and tests.							
Reports on the relationship between Residential area and tests.	x	x	√	x	x	x	**17%**
Reports on the relationship between age and types of radiology test.	√	√	√	√	x	√	**83%**
Reports on the relationship between Residential area and types of radiology test.	x	√	√	x	x	x	**33%**
Reports on the relationship between gender types of radiology test.	√	√	√	√	x	√	**83%**
Reports on the relationship between job types of radiology test.	x	√	√	x	x	√	**50%**
Reports predict which patients are most exposed to risk based on their disease inputs.	√	x	√	x	√	√	**67%**
Expected cost of a specific case suffer from a chronic disease.	√	√	√	√	x	√	**83%**
Expected cost of medications for a patient suffering from chronic disease.	√	√	√	√	√	√	**100%**

Standard	AXA	Inaya Egypt	Misr HCN	Medmark	MedNet	NextCare	Percentage
Expected cost for tests of a patient suffering from a chronic disease.	√	√	√	√	√	√	**100%**
Expected cost of radiology tests for a patient suffering from chronic disease.	√	√	√	√	√	√	**100%**
Expected costs for all patients in the next year	√	√	√	√	√	√	**100%**
Cost paid to service providers in a specific period (last year, current, specific period)	√	√	√	√	√	√	**100%**
The cost required from companies benefiting from the service	√	√	√	√	√	√	**100%**
Total	**%79**	**%89**	**%100**	**21%**	**%79**	**%82**	

NextCare Company indicated during a personal interview with the medical director that when a specific entity, such as banks, requests a report from the insurance company about the most common diseases or radiology tests associated with a group of employees, the company provides customized reports. These reports are prepared with input from the company's medical director. For example, if a report shows that many employees suffer from spine and neck problems, the entity might be advised to change the type of chairs used by its employees.

Data integration, sharing and backup

The healthcare management companies under study achieved 85.5% of their data integration and sharing capabilities. NextCare, MedNet, Egypt HCN, and MedMark met 100% of the data integration, sharing, and backup criteria. Inaya Egypt followed with 75%, as it was unable to collect health data from disparate sources. AXA came in last with 50%. It is worth noting that all companies achieved 100% for the backup standard, with daily backups in place.

Table 6 Ability to integrate, share and backup data in healthcare management companies

Standard	AXA	Inaya Egypt	Misr HCN	Medmark	MedNet	NextCare	Percentage
Ability to merge data from different sources	x	√	√	√	√	√	**83%**
Ability to collect health data from disparate sources, such as clinical, financial, and administrative data.	x	x	√	√	√	√	**67%**
Is the backup of data taking	√	√	√	√	√	√	**100%**
Is the backup taking on (daily, weekly, monthly, quarterly, semi-annually, annually) basis?	**D**	**D**	**D**	**D**	**D**	**D**	**100%**
Total	**50%**	**75%**	**100%**	**100%**	**100%**	**100%**	

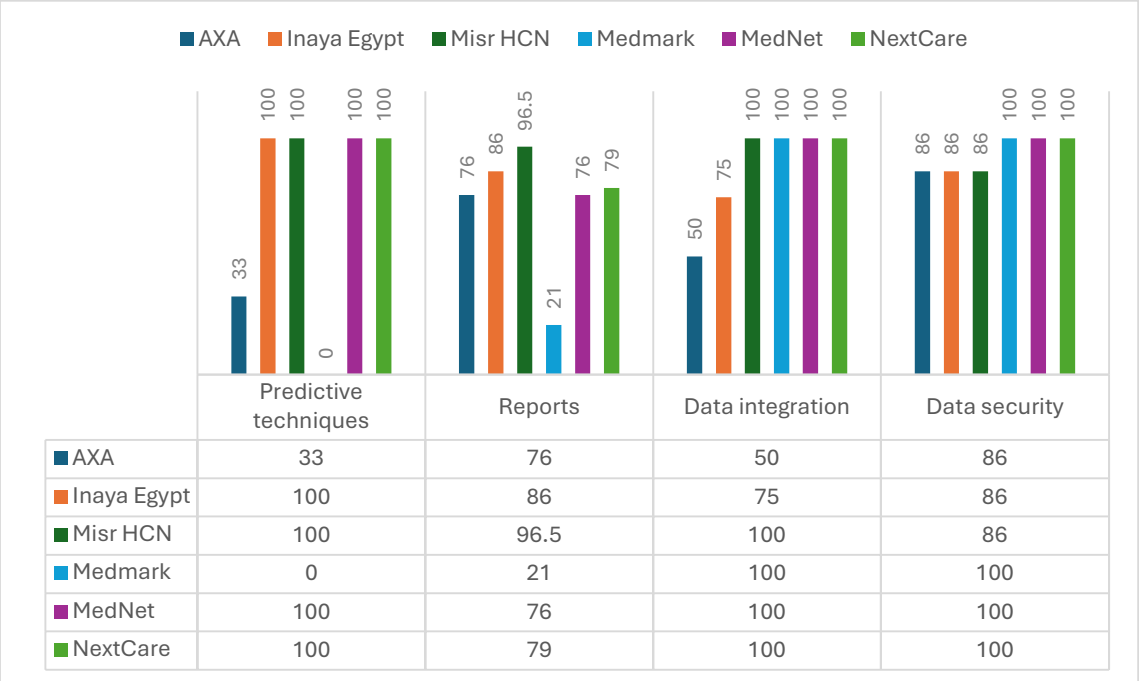
Data Security and Privacy

The big data of the healthcare management companies studied achieved 93% of the data security and privacy standard. Misr HCN, with 86%, achieved the highest data preservation rate, preventing the deletion of any data from its records, regardless of the employee's authority. AXA maintained all standards related to data security and privacy but allowed files to be completely destroyed, which differs from all other companies. The researcher believes that the inability to completely destroy a file is an advantage in health information management systems, and the possibility of destroying a file, even if it can be hidden, is a disadvantage. Inaya Misr, on the other hand, failed to maintain patient data privacy by not hiding the patient's identity, which contradicts the International Telecommunication Union (ITU)'s guidelines on the necessity of digitizing clinical data sets while ensuring their identity remains concealed (Stankovic, Garba and Neftenov 2021).

Table 7 Healthcare Management Companies Data Security and Privacy

Standard	AXA	Inaya Egypt	Misr HCN	Medmark	MedNet	NextCare	Percentage
require username and password to log in to the system .	√	√	√	√	√	√	100%
Defines user privilege upon log in which enable/restrict functions or accessing data accordingly.	√	√	√	√	√	√	100%
Ability to hide patient identity	√	x	√	√	√	√	83%
Ability to hide some patient's health data	x	√	√	√	√	√	83%
Ability to delete data (for those who have permission to do so)	√	√	x	√	√	√	83%
Ability to recover deleted data	√	√	√	√	√	√	100%
The file cannot be destroyed.	x	√	√	√	√	√	83%
Total	86%	86%	86%	100%	100%	100%	

The following figure shows a comparison between healthcare management companies in the application of measurable standards:



	Predictive techniques	Reports	Data integration	Data security
AXA	33	76	50	86
Inaya Egypt	100	86	75	86
Misr HCN	100	96.5	100	86
Medmark	0	21	100	100
MedNet	100	76	100	100
NextCare	100	79	100	100

Figure 3 Comparison of Healthcare Management Companies in Implementing Measurable Standards

Discussion

The study aimed to explore the readiness of healthcare management companies to integrate and share their big health data in framework of digital transformation to support Egypt's sustainable development strategy and achieve Egypt's Vision 2030. To achieve this goal, it was necessary to know the reality of the cooperation and coordination between healthcare management companies, which officially represent Egyptian private insurance companies, and government agencies responsible for healthcare, such as General Authority for Healthcare Accreditation and Regulation, the Ministry of Health, the General Authority for Health Insurance, and the Health Care Authority.

To achieve these goals, a checklist consisting of 71 items was designed, while filled by healthcare management companies representative that handle big health data. All healthcare management companies involved in the study agreed that there was no communication or coordination between them and the Ministry of Health, the General Authority for Health Insurance, the General Authority for Healthcare Accreditation and Regulation, or the Healthcare Authority. Also, when consulting the insurance companies with medical activity that license these companies, it was confirmed that there was no coordination between them. This indicates that each company operates in isolation, without any reference to big health data and its governance, and that government healthcare organizations do not benefit from the huge health data bank of insurance companies or healthcare management companies.

The demographic data standard achieved only 67%, and incomplete demographic data affects the quality of relevant data and reports. It also limits the full use of predictive capabilities, such as linking the most important diseases to a specific job or place of residence. All companies agreed to use a unique identifier for each patient, which is a code specific to the company's system. The researcher believes that using the national ID as a unique identifier across all companies would enable data integration and ensure that patient data is not duplicated.

All healthcare management companies agreed to use standardized drop-down menus for the International Classification of Diseases (ICD) and the Medical Procedure Description (CPT) code, ensuring uniformity of medical terminology and accuracy of entries across all companies. The criteria for adding patient examination and radiology results achieved only 67%, which directly affects the preparation of reports on the patient's expectations from examinations and radiology, as well as the patient's medical record and health condition over time. The criteria for selecting the diseases related to prescribed medications achieved 100%, helping provide clear insights into the most common diseases that require certain medications. This directly helps the pharmaceutical industry.

(Mucci and Stryker 2024), (Hassani, Unger and Beneki 2020), and (Wang, Kung and Byrd 2018) agreed that predictive methods and analytics are among the most important features and categories of health big data analysis. This aligns with the current study, which found that the companies under study achieved 72% of the predictive capabilities standard. Despite AXA ranking second in terms of the volume of its big health data, it only achieved 33% of the predictive capabilities standard. In contrast, MedMark failed to achieve any benefits from its big health data in predictive analytics, not achieving any of the predictive capabilities standards.

(Zillner and Neururer 2016) indicated that the highest impact of big data health applications can be achieved when data is obtained from various sources, such as clinical data, financial and administrative claims, and pharmacy data. By combining these different aspects, new insights can be gained. This is what Egypt HCN excelled in by achieving 100% of the reporting standards. While data analysis techniques, such as data mining and predictive analytics, help discover patterns, relationships, and trends within data, providing a strong basis for informed decision-making (Mucci and Stryker 2024), some companies that were keen to complete all demographic data, such as AXA and MedMark, were no better than companies that did not complete all demographic data, such as NextCare and MedNet, in making the best use of that data, as they failed to provide reports linking the job or place of residence to the most important diseases, tests, and radiology. Despite MedMark's concern to complete all data inputs, it used that information in reports only 21% of the time, focusing mainly on financial reports. Thus, it only achieved 75% of the reporting standard based on data analysis.

The World Health Organization's Global Report on Health Data Systems and Capabilities (WHO 2021) stressed the need to enable, obtain, and share data in accordance with international standards of confidentiality and information security. Although Enaya Egypt and AXA failed to collect health data from disparate sources, such as clinical, financial, and administrative data, and AXA was unable to merge data from different sources, the standard for integrating, sharing, and backing up data in general was achieved a rate of 87.5% across all the companies studied.

Both (Berthelé 2018)and (Wu, et al. 2022)indicated that one of the basic criteria for data security and privacy, which must be taken into account, is the technical measures that ensure the possibility of hiding the identity in order to protect the rights of the data owner. Inaya Egypt was the only company that was unable to achieve this standard from the companies under study, while Misr HCN preserved the patient's private data by preventing the permanent destruction of the patient's file. As a result, the data security and privacy standard was achieved at a rate of 93% across the companies under study.

Conclusion and Recommendations

The study concluded that there is no coordination between healthcare management companies, which are officially authorized by private Egyptian insurance companies, and government agencies responsible for healthcare, such as the General Authority for Health Insurance, the General Authority for Healthcare Accreditation and Regulation, the Ministry of Health, and the Healthcare Authority. Each company operates separately, without any reference to big health data, governance of the health sector, and activation of digital transformation. However, all healthcare management companies have big health data and maintain high quality. Their predictive capabilities, based on these inputs, achieved at a rate of 72%. Additionally, they were able to analyze these capabilities into detailed reports at a rate of 75%, and their ability to share and integrate data reached 87.5%. Furthermore, all companies successfully achieved 93% in data security and privacy, confirming their readiness to support the sustainable development strategy outlined in Egypt's Vision 2030.

Based on these findings, this study recommends the necessity of coordination between government agencies responsible for healthcare and healthcare management companies to exchange and integrate big health data while maintaining global standards for the confidentiality of health data. There should also be coordination between the Egyptian Drug Authority and healthcare management companies regarding the most commonly drugs used. Additionally, implementing a law that mandates the use of health information technology and the reliance on health records by all healthcare providers in both the private and governmental sectors within the Egypt is essential.

Using the national ID as a unique, unified identifier for the patient in all companies, as well as for health service providers, can ensure that patient data is not duplicated when it is merged and governed. Decision-makers should also benefit from reports generated by healthcare management companies, such as identifying the most important diseases in general, diseases prevalent in specific residential areas, and annual expenditures of Egyptians on medicines and health care services. Furthermore, the vast health data should be leveraged to create an Egyptian health data bank that includes all health records of citizens in both the private and government health insurance sectors.

Limitations

A limitation encountered in this study was the absence of an official body that lists healthcare management companies in Egypt, as along with the refusal of some companies to cooperate with the researcher. Additionally, there was difficulty in obtaining quick responses from healthcare management companies.

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Annexe 1 Check list

The Role of Healthcare Big Data in Healthcare Management Companies Supporting the Sustainable Development Strategy of Egypt Vision 2030: An Exploratory Study

Main Data					
1.	Size of big health data	…TB	… BB	… EB	
2.	Number of patients in the system				
3.	Total number of patients with complete data				
4.	Is there any coordination between the company and the General Authority for Health Accreditation and Supervision				
5.	Is there any coordination between the company and the Ministry of Health				
6.	Is there any coordination between the company and the Health Care Authority				
7.	Is there any coordination between the company and the General Authority for Health Insurance				
Quality of Data					
8.	Type of demographic data	Full name	age	job	address
9.	Use unique ID for each patient				
10.	Patient ID Type	Serial number	National ID	Code	
11.	Each patient has only one identifier, ensuring that there are no two identifiers for the same patient.				
12.	All entries are dated and clearly identified with the name and position of the person who wrote them.				
13.	Report is written in natural language				
14.	Report is entered by the ICD drop -down menus				
15.	Diagnosis can be combined with the choice between ICD and adding a natural language explanation of the condition if necessary				
16.	Medications required are entered via natural language.				
17.	Medicines are selected from drop-down menus.				
18.	When writing the medication, can choose from drop down menus and explain the condition in natural language if necessary.				
19.	Medication is indicated if it is chronic or non-chronic.				
20.	Duration of treatment is entered .				
21.	Type of disease is selected for the prescribed ICD medications.				
22.	Tests required are entered in natural language.				
23.	Tests are selected by selecting the CPT dropdown menus				
24.	When writing the Tests, can choose from drop down menus and explain the condition in natural language if necessary.				

25.	Type of disease is selected for the tests described by ICD dropdown menus.	
26.	Record test results for patients.	
27.	The required radiology test results are written in natural language.	
28.	Radiology tests are selected from the CPT drop -down menus.	
29.	When writing the radiology test, can choose from drop down menus and explain the condition in natural language if necessary.	
30.	Type of disease is selected for the prescribed radiology tests from ICD drop down menus .	
31.	Record radiology tests result for patients	
Predictive capabilities: **After collecting data**, **can the company**:		
32.	Generate usage indicators can predict and provide insights into high-risk patients.	
33.	Predicts future expenses and calculates the probability of one or more hospital admissions.	
34.	Provide classified indicators for future usage to support healthcare, manage medical conditions and support insurance experts.	
Reports: **After collecting the data**, **can the company issue reports on**:		
35.	Types of diseases covered	
36.	The financial cost generally according to the type of disease in a specific period (previous, subsequent)	
37.	Financial cost generally, according to test types in specific period (previous, subsequent)	
38.	Financial cost generally, according to Radiology test types in a specific period (previous, subsequent)	
39.	Reports on the relationship between age and diseases.	
40.	Reports on the relationship between gender and diseases.	
41.	Reports on the relationship between jobs and diseases.	
42.	Reports on the relationship between Residential area and diseases.	
43.	Most types of diseases in a specific period.	
44.	Most types of medications in a specific period.	
45.	Most types of tests in a specific period.	
46.	Most types of radiology tests in a specific period.	
47.	Reports on the relationship between age and tests.	
48.	Reports on the relationship between gender and tests.	
49.	Reports on the relationship between job and tests.	
50.	Reports on the relationship between Residential area and tests.	
51.	Reports on the relationship between age and types of radiology test.	
52.	Reports on the relationship between Residential area and types of radiology test.	

53.	Reports on the relationship between gender types of radiology test.	
54.	Reports on the relationship between job types of radiology test.	
	Report that can predict which patients are most exposed to risk based on their disease inputs.	
55.	Expected cost of a specific case suffer from a chronic disease.	
56.	Expected cost of medications for a patient suffering from chronic disease.	
57.	Expected cost for tests of a patient suffering from a chronic disease.	
58.	Expected cost of radiology tests for a patient suffering from chronic disease.	
59.	Expected costs for all patients in the next year	
60.	Cost paid to service providers in a specific period (last year, current, specific period)	
61.	The cost required from companies benefiting from the service	
Data integration, **sharing and backup**		
62.	Ability to merge data from different sources	
63.	Ability to collect health data from disparate sources, such as clinical, financial, and administrative data.	
64.	Is the backup of data taking	
65.	Is the backup taking on (daily, weekly, monthly, quarterly, semi-annually, annually) basis?	
Data Security and Privacy		
66.	require username and password to log in to the system .	
67.	Defines user privilege upon log in which enable/restrict functions or accessing data accordingly.	
68.	Ability to hide patient identity	
69.	Ability to hide some patient's health data	
70.	Ability to delete data (for those who have permission to do so)	
71.	Ability to recover deleted data	
72.	The file cannot be destroyed.	

دور البيانات الضخمة الصحية بشركات إدارة الرعاية الصحية في دعم استراتيجية التنمية المستدامة لرؤية مصر 2030: دراسة استكشافية

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المستخلص

تهدف رؤية مصر 2030 إلى إتاحة خدمات صحية مميزة، ومن سُبل تحقيق هذا الهدف هو تطبيق قانون التأمين الصحي وتوحيد الأوعية التأمينية وتحسين حوكمة القطاع الصحي وإعادة هيكلته، بالإضافة إلى تحسين البنية التحتية وتفعيل التحول الرقمي وذلك لضمان وجود نظام موحد للمعلومات الصحية، ولهذا هدفت الدراسة إلى استكشاف دور البيانات الصحية الضخمة لسجلات شركات إدارة الرعاية الصحية في دعم استراتيجية التنمية المستدامة لتحقيق رؤية مصر2030، مستخدمة في ذلك منهج دراسة الحالات المتعددة، حيث تم الاعتماد على قائمة مراجعة مكونة من 71 عنصرًا، كأداه لجمع البيانات، وقد أظهرت الدراسة عدة نتائج أبرزها عدم وجود أي تنسيق بين شركات التأمين المصرية الخاصة، والتي تمثلها شركات إدارة الرعاية الصحية، مع الهيئات الحكومية المنوطة بالرعاية الصحية، وجاهزية شركات إدارة الرعاية الصحية لحوكمة بياناتها والتحول الرقمي حيث أن جميع شركات إدارة الرعاية الصحية لديها بيانات صحية ضخمة وتتمتع بجودة بياناتها، وقدرتها التنبؤية بنسبة 72% والتقارير الناتجة من تحليل المدخلات بنسبة 75% بالإضافة إلى دمج البيانات ومشاركتها بنسبة 87.5% وأمن وخصوصية البيانات بنسبة 93%.

الكلمات المفتاحية: البيانات الضخمة؛ البيانات الصحية؛ شركات إدارة الرعاية الصحية؛ شركات التأمين؛ التأمين الصحي، التنمية المستدامة؛ رؤية مصر 2030.