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# Academia Open



*By Universitas Muhammadiyah Sidoarjo*

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# Academia Open

Vol. 11 No. 1 (2026): June  
DOI: 10.21070/acopen.11.2026.13760

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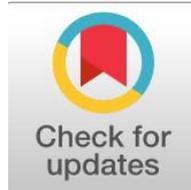
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# The Impact Of Technological Advancements In Radiology And Ultrasound Equipment And Banking Innovation On Improving The Efficiency Of Healthcare Investment : A Proposed Analytical Framework For Applied And Financial Sciences

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## Abstract

**General Background:** Healthcare systems increasingly require alignment between technological modernization and financial mechanisms to support sustainable investment management. **Specific Background:** This study examines technological advancements in radiology and ultrasound equipment together with banking innovation as complementary dimensions within Iraqi healthcare institutions. **Knowledge Gap:** Previous studies addressed technological development and financial innovation separately, while analytical models integrating both applied medical and financial perspectives remain limited. **Aims:** The research aims to construct and empirically test an analytical framework explaining the relationship between medical technology development, banking innovation, and healthcare investment efficiency. **Results:** Using a descriptive-analytical approach based on literature review and questionnaire data from 103 healthcare and banking employees analyzed through SPSS and Excel, the findings reveal statistically significant positive relationships among variables, with technological development showing the strongest regression coefficient ( $\beta = 0.52$ ) followed by banking innovation ( $\beta = 0.39$ ). The combined model explains 64% of the variance in healthcare investment efficiency ( $R^2 = 0.64$ ). **Novelty:** The study introduces an integrated analytical framework linking diagnostic technology modernization with innovative financing mechanisms within a unified applied and financial sciences perspective. **Implications:** The findings support coordinated technological modernization programs, flexible financing policies, and expanded financial technology adoption to support sustainable healthcare investment and improved resource management in developing healthcare systems.

### Highlights:

- Statistical Model Accounted for 64% Variance in Investment Performance Outcomes.
- Diagnostic Equipment Modernization Showed the Highest Regression Contribution.
- Survey Responses Demonstrated Strong Cross-Sector Awareness of Technology–Finance Alignment.

**Keywords:** Medical Technology, Banking Innovation, Healthcare Investment Efficiency, Radiology Equipment, Financial Integration

Published date: 2026-02-26

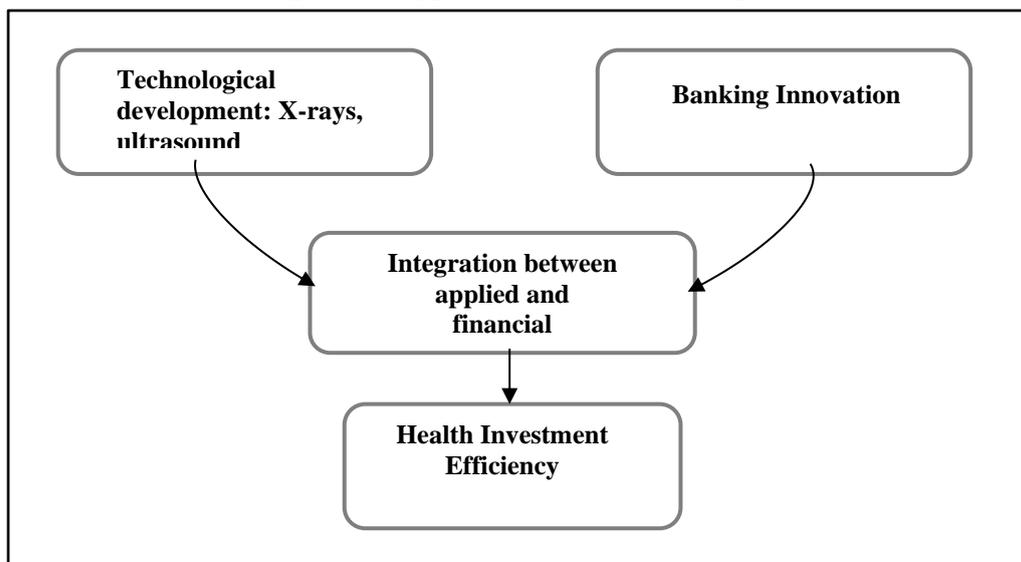
## 1- Introduction

This research aims to analyze the impact of technological advancements in radiology and ultrasound equipment, along with banking innovation, on enhancing the efficiency of healthcare investment in Iraq. This is achieved by examining the relationship between technological progress in medical diagnostic tools and the adoption of innovative financing tools in the banking sector. These two elements are considered complementary in promoting the efficient management of investment resources within healthcare institutions. The healthcare investment efficiency variable was chosen as the dependent variable in this research because it represents the comprehensive standard by which effectiveness, sustainability, and the balance between quality and cost are measured. This reflects the ability of healthcare institutions to maximize the return on their investments in an environment characterized by rapid technological and financial developments.

The importance of this research stems from the limited integration between technological advancements in medical equipment and banking innovation in financing the healthcare sector in Iraq, despite the significant expansion in each separately. The research gap lies in the absence of analytical models that integrate the technological and financial dimensions to explain their combined impact on improving healthcare investment efficiency. This research seeks to address this gap by constructing an analytical framework that clarifies the mechanisms of this integration and its impact in practice.

In order to achieve the research objectives systematically, the research structure was divided into four main axes: The first axis adopted the research methodology, while the second axis reviews the conceptual and theoretical aspect of the three variables: technological development in radiology and ultrasound devices, banking innovation, and the efficiency of health investment. The third axis includes the applied aspect through the analytical framework of the model and statistical tests to verify the research hypotheses. The research concludes with the fourth axis, which presents the most important conclusions and recommendations that can contribute to enhancing the integration between technological development and banking innovation in order to achieve the sustainability of health investment in Iraqi institutions.

**Figure (1) Hypothetical Research Diagram**



Source: Prepared by the researcher based on literature

## 2- Review of Previous Studies:

### 1. Hosny et al. [1]

The study, titled "Artificial Intelligence in Radiology," aimed to analyze the impact of using artificial intelligence techniques in radiology on diagnostic accuracy and the speed of medical decision-making

The study concluded that integrating artificial intelligence into radiology equipment enhances diagnostic performance and reduces the likelihood of error, thus supporting the efficiency of investment in modern equipment

### 2. Meiling[2]

The study, titled "Financial Innovation and Health Sector Financing," used banking innovation as a tool to develop healthcare sector financing through the application of modern financial models such as leasing and Islamic finance

The results showed that diversifying financing tools contributes to achieving financial sustainability for healthcare institutions and increases the efficiency of resource allocation.

### 3. Rahman & Chen [3]

The study, entitled "Performance Measurement in Healthcare Investment" focused on indicators for measuring the efficiency of healthcare

investment through an analysis of the balance between quality and cost. The study concluded that adopting financial and technical performance evaluation systems increases the effectiveness of healthcare investment and enhances its long-term sustainability.

## First Axis : Research Methodology

### 3-Research Methodology:

This research adopted the descriptive-analytical method, as it is suitable for the nature of the study, which combines theoretical and field aspects. This method was employed through:

1. Analyzing the literature and previous studies related to technological development in radiology and ultrasound equipment, banking innovation, and the efficiency of healthcare investment.
2. Collecting and analyzing field data using a questionnaire to examine the relationship between variables.

### 1-3 Significance of the Research:

The significance of this research stems from its integration of applied (medical) sciences and financial sciences within a single framework, opening new horizons for understanding the integration between technological development and healthcare financing to achieve effective and sustainable investment. The significance is manifested in the following:

1. Enriching the theoretical aspect by building an analytical framework that links technological development and banking innovation.
2. Supporting decision-makers in the healthcare and banking sectors to adopt integrated financing and technological modernization policies.
3. Providing practical recommendations to develop the efficiency of healthcare investment and improve resource allocation.

### 2-3 Research Problem

The healthcare sector in Iraq is witnessing rapid advancements in medical equipment, particularly radiology and ultrasound devices, which are characterized by high acquisition, operation, and maintenance costs. Meanwhile, banks are expanding the scope of banking innovation by developing modern financing tools that contribute to supporting productive and service sectors, including the healthcare sector.

However, the integration between technological advancements in medical equipment and banking innovation remains limited, leading to inefficient healthcare investment and an inability to optimally utilize modern technologies. Therefore the research problem is represented by the following main question:

**- To what extent do technological advancements in radiology and ultrasound devices and banking innovation contribute to improving the efficiency of healthcare investment within Iraqi medical institutions ?**

**This main question branches into the following sub-questions :**

1. What is the impact of technological advancements in radiology and ultrasound devices on the efficiency of healthcare investment ?
2. How does banking innovation in financing the healthcare sector improve resource management and increase efficiency ?
3. What is the nature of the interactive relationship between technological advancements and banking innovation in achieving the sustainability of healthcare investment ?

### 3-3 Research Objectives

The main objectives of this research are as follows :

1. To analyze the impact of technological advancements in radiology and ultrasound equipment, specifically in terms of (high accuracy, speed and efficiency, artificial intelligence, and integration with hospital systems), on enhancing the efficiency of healthcare investment within medical institutions.
2. To identify the role of banking innovation in financing the healthcare sector through (diversified financing tools, the use of financial technology, flexibility, and compliance with regulations) in improving the efficiency of investment resource management.
3. To measure the efficiency of healthcare investment across its dimensions of (effectiveness, sustainability, measurement, and the balance between quality and cost) to determine the level of improvement resulting from technological advancements and banking innovation.
4. To interpret the interactive relationship between independent and dependent variables within an applied model that demonstrates how combining modern technology and banking innovation contributes to achieving more efficient and sustainable healthcare investment.

### 4-3 Research Hypothesis

**Based on the research objectives and problem, the following hypotheses were formulated:**

1. There is a statistically significant relationship between technological advancements in radiology and ultrasound equipment and the efficiency of healthcare investment within healthcare institutions.
2. Technological advancements in radiology and ultrasound equipment have a statistically significant impact on promoting banking innovation

aimed at financing the healthcare sector.

3. Banking innovation contributes statistically to increasing the efficiency of healthcare investment.

4. The integration of technological advancements in medical equipment and banking innovation leads to higher efficiency and sustainability in healthcare investment.

### 5-3 Research Population

The research population consists of two categories:

**1. Theoretical Population:** Published scientific studies in the fields of technological development, medical imaging, banking innovation, and healthcare financing.

**2. Field Population:** Employees in the healthcare and banking sectors who are relevant to the research topic.

### 6-3 Research Sample

#### A. Research Sample (Theoretical Aspect)

This sample consisted of (25) peer-reviewed scientific studies selected purposively. These studies were analyzed, and theoretical indicators supporting the development of the analytical research framework were extracted. A convenience sample was adopted due to its suitability for the descriptive-analytical nature of the research and the difficulty of fully encompassing the field population. The diversity of the sample and its representation of both the healthcare and banking sectors were also ensured.

#### B. Field Sample

This sample consisted of (103) valid responses collected through a questionnaire distributed to a convenience sample of employees in the healthcare and banking sectors, This data was used to statistically test the hypotheses.

### 7-3 Data Collection Tools

**1. Theoretical Tool:** Analysis of previous studies using the comparative analysis method.

**2. Field Tool:** A questionnaire based on a five-point Likert scale, designed to measure the research variables (technological development, banking innovation, and the efficiency of healthcare investment).

### 8-3 Statistical Methods

The data were analyzed using SPSS software according to the following methods:

1. Descriptive Statistics

2. Pearson Correlation

3. Multiple Linear Regression

4. Hypothesis Testing at a significance level of 0.05

- The descriptive comparative analysis of the theoretical data was combined with the quantitative analysis of the field data to achieve a comprehensive view of the relationship between theory and practice.

### Second Axis : Conceptual Aspect

#### 4- Technological Development of Radiology and Ultrasound Equipment

##### 1-4- The Concept

Technological development in radiology and ultrasound equipment encompasses a range of mechanical, electronic, and software technologies introduced into medical imaging tools to enhance diagnostic performance and the accuracy of clinical results. This development includes updates to the hardware components of the equipment, such as detection and processing systems, and to the software components through the use of artificial intelligence and image analysis algorithms. It also involves improving operating interfaces and network integration among medical devices within healthcare institutions [1].

Smith & Jones further explained that technological development in medical imaging is one of the most significant aspects of the digital revolution in healthcare [4]. It has not only improved image quality but also incorporated intelligent systems capable of interpreting medical data and reducing the likelihood of human error in diagnosis. This development is reflected in the view of Kalra & Homayounieh that it has contributed to a qualitative leap in radiology practices through technologies such as multi-slice CT, high-resolution MRI, and 3D/4D ultrasound [5]. Therefore, the researcher argues that technological advancements in radiology and ultrasound equipment represent not merely a technical update, but a strategic shift in the concept of medical diagnosis. This shift combines engineering innovation, intelligent software analysis, and institutional integration within a single framework that enhances performance efficiency and the quality of healthcare.

##### 2-4- The Objectives:

The impact of technological advancements in radiology and ultrasound equipment is evident through a set of objectives that aim to demonstrate its

role in enhancing the efficiency and accuracy of medical imaging and improving the quality of healthcare services, as follows:

1. Identifying the impact of technological advancements in improving the accuracy and efficiency of radiology and ultrasound equipment, thereby contributing to improved medical diagnosis [6]. Explaining the role of modern technological innovations, such as multi-slice CT and high-resolution MRI, in enhancing early disease detection capabilities [7].
3. Highlighting the relationship between software and digital advancements in medical imaging equipment and their support for accurate clinical decision-making [8].
4. Assessing the extent to which 3D and 4D ultrasound technologies monitor the progression of disease cases and improve the quality of healthcare [9].
5. Investigating the impact of automation and artificial intelligence integrated into radiology equipment on the speed and efficiency of medical diagnostic processes [10].

### 3-4-The Dimensions

These dimensions represent the conceptual framework for technological development in radiology and ultrasound equipment, through which the impact of performance efficiency and quality of health services can be analyzed. They include the following [11][12] [13]

**1. High Accuracy:** Modern technologies have contributed to the production of high-quality radiographic images, thus reducing errors in medical diagnosis.

**2. Speed and Efficiency:** Faster processing and improved image compression algorithms have enabled the completion of a greater number of examinations within a limited timeframe, significantly increasing the efficiency of healthcare services.

**3. Artificial Intelligence and Advanced Analysis:** The use of artificial intelligence techniques in medical image analysis has become widespread. By recognizing subtle patterns that traditional human diagnosis might miss, artificial intelligence enhances the accuracy and objectivity of medical interpretation.

**4. Integration with hospital systems:** The integration of modern devices with hospital information systems (HIS) and picture archiving and communication systems (PACS) makes it easy to save and share medical data accurately and quickly between doctors and different departments.

### 5-Banking Innovation

#### 1-5-The Concept

The concept of banking innovation refers to the set of new financial processes, methods, and technologies that banking institutions apply to develop their financial products and services, thereby increasing efficiency to meet diverse economic needs. In the context of the healthcare sector, banking innovation refers to the development of innovative and diverse financing tools that respond to the growing demands of healthcare institutions, such as financing the purchase of modern medical equipment, expanding hospital infrastructure, or providing emergency liquidity to address health crises [14]. Furthermore, banking innovation in healthcare financing serves as a strategic tool to enhance the sustainability of healthcare financing and enable institutions to meet financial challenges, particularly in economies suffering from financing gaps or non-comprehensive health insurance systems [15]

❖ This is exemplified by the application of advanced financial models, such as:

**1. Leasing Finance:** This helps hospitals and healthcare institutions utilize medical equipment without the need for outright purchase, thus reducing financial burdens and enhancing operational flexibility [16].

**2. Islamic Finance:** Based on the principles of partnership, profit-sharing, and leasing, this provides Sharia-compliant financing alternatives that meet the investment needs of healthcare institutions.

**3. Financial Technology (FinTech):** This technology provides innovative digital platforms for direct or crowdfunding, facilitating access to diverse funding sources and increasing transparency and efficiency in financial operations [17]. Banking innovation is not limited to simply introducing new financial instruments; it extends to becoming a strategic mechanism for enhancing integration between banks and healthcare institutions, improving financial resource management, and reducing financing risks, thereby contributing to the sustainability of the healthcare sector and expanding financial coverage [18] [19]

From this perspective, the researcher believes that banking innovation is a fundamental pillar for developing flexible and effective healthcare financing systems, especially in light of the economic challenges and pressures resulting from the increasing needs for healthcare.

#### 2-5-The Importance

The importance of banking innovation lies in the use of advanced financial tools that enhance the efficiency of healthcare investment and improve resource allocation. This reduces waste and increases the return on investment in medical equipment and services, in addition to supporting long-term planning and the use of modern technological innovations. This positively impacts the quality and efficiency of healthcare services provided [20].

The impact of these tools also helps strengthen institutional trust through the diversification of financing instruments to meet the needs of different institutions, the use of financial technology (FinTech) to facilitate access to financial resources, and the flexibility to adjust financing terms according to operational needs. This contributes to the development of the healthcare sector and increases its ability to adapt to market changes [21]. Flexible financing and banking innovation are prominent in enabling institutions to renew their medical equipment and modernize their infrastructure

without relying entirely on government budgets. This improves the quality of diagnostic and treatment services and enhances the institutions' ability to expand and respond to emerging healthcare challenges [22].

### 3-5-The Dimensions

Banking innovation is one of the main drivers for developing the health finance system and enhancing its operational and investment efficiency, as its effects are embodied through a set of dimensions that contribute to expanding the scope of financial services and adapting them to the needs of different health institutions. These dimensions illustrate how modern financial technologies can be employed to improve financial performance and facilitate access to funding resources in more flexible and efficient ways, thereby supporting the sustainability of healthcare systems and the quality of services provided [23]. They also highlight the importance of balancing technological development with compliance with international legislation and standards to ensure the safety and stability of financing in a rapidly changing and highly competitive environment [24]. The main dimensions of banking innovation in the healthcare sector include:

- 1. Diversification of financing instruments:** Designing innovative financial products that are tailored to the nature of each healthcare institution in terms of size, activity, and creditworthiness enhances opportunities for growth and sustainable healthcare investment [23].
- 2. Financial technology (FinTech):** Digital banking applications and platforms have helped accelerate financing procedures, reduce administrative costs, and improve the efficiency of financial operations through automation and intelligent data analytics [24].
- 3. Flexibility:** The tools Innovative banking involves adapting financing terms to market changes or the needs of healthcare institutions, ensuring an effective response to economic challenges and volatile operating conditions [25].
- 4. Compliance with Regulations:** Banking innovation ensures that its operations align with local and international legal frameworks, including Islamic finance regulations and governance and transparency standards, to guarantee the integrity of financial activities and maintain institutional trust [16].

### 6-Health Investment Efficiency

#### 1-6-The Concept

Health investment efficiency refers to the ability to direct available health resources—whether financial, human, or technological—in a way that achieves the highest possible health outcomes at the lowest possible cost, while maintaining sustainability and quality in service delivery [26]. Efficiency goes beyond mere financial savings to include maximizing the utilization of human, medical, and technological infrastructure resources, thereby ensuring improved access to healthcare, increased patient satisfaction, and enhanced public health indicators [27]. The efficiency of healthcare investment is based on sound strategic planning and banking and technological innovation. Studies show that healthcare systems that invest wisely in modern medical equipment, human resource development, or enhanced digital infrastructure achieve optimal health outcomes and greater effectiveness compared to systems lacking sound investment planning. This concept is also linked to the principle of healthcare sustainability, which means the optimal use of resources while considering their ability to support the healthcare system in the long term and avoiding waste or excessive spending without tangible returns on patient health. Healthcare investment efficiency also includes the ability to assess the impact of each healthcare investment, monitor performance, and ensure the integration of different resources to achieve the desired goals [9]. The researcher views healthcare investment efficiency as an integrated framework that combines sound resource management, innovation, strategic planning, and continuous analysis of health impact to ensure the best possible outcomes at the lowest possible cost.

#### 2-6-The Importance

Efficient health investment contributes to achieving a real return on invested financial resources, thus supporting the effectiveness of health spending and the confidence of investors and supporting institutions. It also enhances future resource planning through performance analysis to achieve long-term results. Furthermore, efficient health investment helps reduce financial and administrative waste by improving spending management and raising the quality of services, leading to improved healthcare quality and patient satisfaction through faster diagnosis, more accurate treatment, and reduced procedure times [16].

#### 3-6-The Dimensions

The effectiveness of health investment is manifested through a set of key dimensions, including:

- 1. Effectiveness:** The ability to achieve desired health outcomes with the highest possible efficiency in resource utilization, while closely monitoring outputs against inputs [28].
- 2. Sustainability:** Through the adoption of long-term investment plans that ensure the continuous provision of high-quality health services without interruption [29].
- 3. Measurement and Evaluation:** Using clear quantitative and qualitative indicators such as recovery rates, patient satisfaction levels, and return on investment in the healthcare sector [3].
- 4. Balancing Quality and Cost:** To ensure the provision of effective healthcare without placing excessive financial burdens on the healthcare system [30].

### 7- Integration of Applied and Financial Sciences in the Health Sector

The integration of applied and financial sciences in the health sector is considered one of the modern trends that aim to raise the efficiency of health systems and achieve sustainability in resource management. This is done by combining technological development in medical devices, especially in

the fields of radiology and ultrasound, with banking innovation in modern financing tools, which ensures raising the quality of health services and achieving economic feasibility, thus promoting the building of an integrated health model that balances accurate diagnostic performance, effective financial management, and sustainable investment in medical infrastructure [31].

### 1-7 - Integration in research is embodied through the following pillars:

#### 1-1-7-Technological Development of Radiology and Ultrasound Devices

**A. Diagnostic Performance Efficiency:** Sensitivity and specificity have emerged as two of the most important accuracy measures in diagnostic evaluation. They are used to determine the device's ability to detect pathological conditions and exclude non-pathological ones with high accuracy. A report in the American Journal of Radiology (AJR) indicated that the use of artificial intelligence systems in analyzing radiological images significantly improves diagnostic performance [32].

**B. The Role of Artificial Intelligence in Medical Imaging:** Studies published in the arXiv database have shown that deep neural network algorithms in analyzing radiological images can achieve high performance with accurate indices, reaching AUC = 95.4%, sensitivity = 91.3%, and specificity = 94.1%, thus enhancing the reliability of medical diagnosis [33].

**C. Operating and Maintenance Costs:** Reports from the American Association for Medical Physicists (AAPM Online Library) indicate that the cost of maintaining medical devices typically constitutes between 5% and 10% of the device's annual purchase price, and can reach 15% for highly complex equipment [34]. A field study published on PubMed, encompassing 19 hospitals, found an average maintenance cost-to-purchase cost ratio of 7.4%, underscoring the importance of adopting an equipment lifecycle management approach [35].

#### 2-1-7- Banking Innovation and Modern Financing Tools in the Healthcare Sector

**A. Diversification of Healthcare Financing Tools:** Banking innovation in healthcare financing includes the development of financial instruments such as leasing, Islamic finance, and health bonds to meet the needs of healthcare institutions in purchasing equipment, expanding infrastructure, and providing liquidity during crises [14].

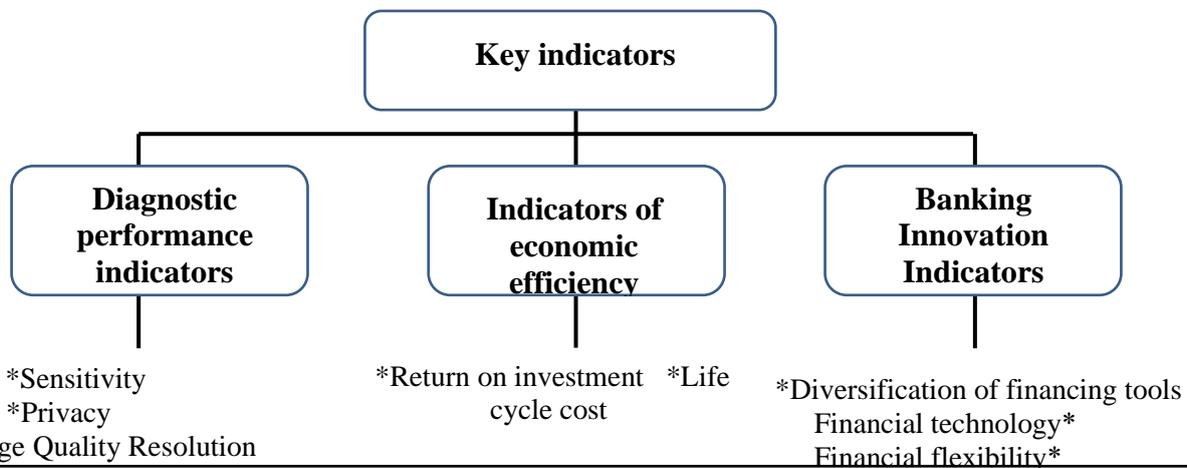
**B. Use of Financial Technology (FinTech):** Financial technologies such as artificial intelligence, blockchain, and cloud computing contribute to accelerating financing processes, improving transparency, and reducing administrative costs. This was demonstrated in the NCBI study on digital transformation in health finance management and the Precision Business Insights report highlighted the growing role of FinTech in enhancing the operational efficiency of healthcare institutions [36][37].

#### 3-1-7-Efficiency and Sustainability of Healthcare Investment

**A. Quality of Healthcare Services:** Improving the quality of diagnosis using advanced imaging technologies leads to a reduction in medical errors and improved patient satisfaction, thus increasing the added value of investment in modern equipment [17].

**B- Sustainability of health investment:** The Life Cycle Costing (LCC) principle is used to assess the long-term economic feasibility of medical equipment. Adopting this model contributes to enhancing the efficiency of health asset management and improving the economic outcomes of medical institutions [36]. Studies indicate that maintenance costs often exceed purchase costs over time, which underscores the importance of applying this principle in health investment planning.

Figure (2) illustrates the key indicators



Source: Prepared by the researcher based on literature

## 2-7- Clarifying the Scope of the Research

It should be noted that this research does not go beyond evaluating the institutional performance of either the Ministry of Health or the Ministry of Finance. Rather, it is limited to analyzing the complementary relationship between technological development in medical devices and banking innovation in financing the health sector, within a purely scientific framework, without issuing evaluative or administrative judgments. This focus aims to highlight how the interaction between technological development and banking innovation contributes to raising the efficiency of health investment. Reports from the Iraqi Ministry of Health confirm this trend, indicating that a number of teaching hospitals – such as Baghdad Medical City and Basra Teaching Hospital – have adopted programs to modernize radiology equipment with joint financing from local banks through instruments such as financial leasing and concessional financing. This has led to improved operational efficiency without constituting an evaluation of the performance of government entities, and is consistent with the scope and scientific objectives of the research [38][39].

### Third Axis: The Applied Aspect

#### 8- Analytical Framework for Research Variable Indicators

The applied analysis aims to examine the impact of technological advancements in radiology and ultrasound (sonography) equipment, and banking innovation in financing the health sector, to enhance the efficiency of health investment within Iraqi institutions. A questionnaire was used to collect data from a sample of (103) responses, which were then analyzed using appropriate statistical methods via Excel and SPSS software to test the field hypotheses related to the relationships between the research variables.

#### 1-8-Descriptive Analysis of Variables

The statistical results showed that the average responses for all questionnaire axes were within the upper limits, indicating a high level of awareness among the study sample regarding the importance of technological development in the healthcare sector and its impact on improving investment efficiency. The overall arithmetic means for the three axes ranged as follows :

**Table (1) Arithmetic Mean**

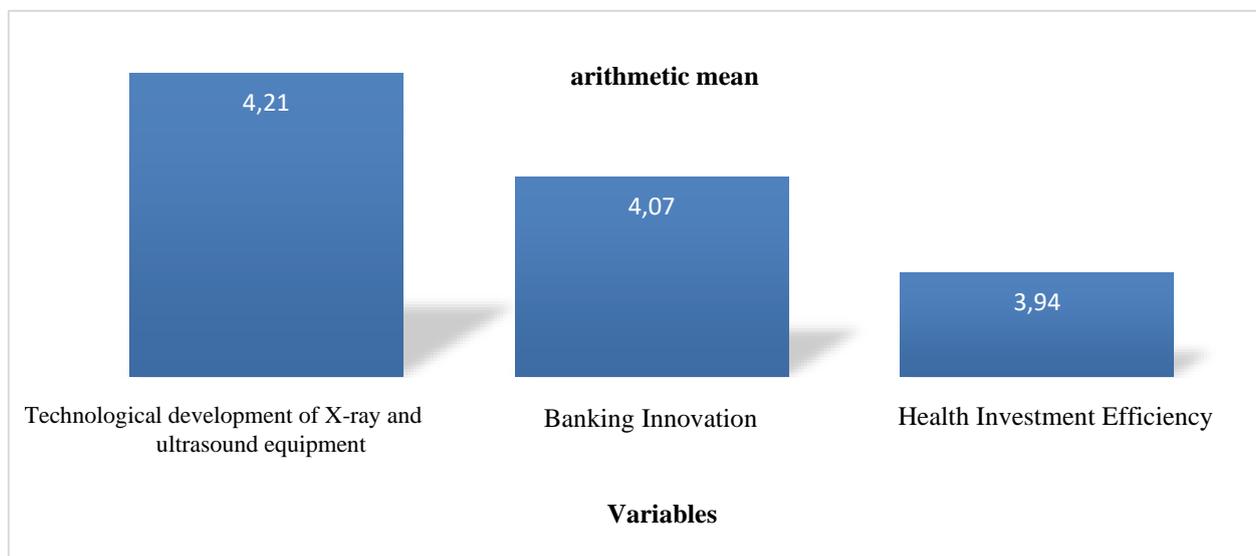
Order	standard deviation	arithmetic mean	variable
1	0.63	4.21	Technological development of X-ray and ultrasound equipment
2	0.68	4.07	Banking Innovation
3	0.71	3.94	Health Investment Efficiency

Source: Prepared by the researcher using SPSS software

institutions.

and their  
of health

**Figure (3) illustrates the average of the research axes**



Source: Prepared by the researcher using Excel software

Figure (3) shows the columns with similar heights between 3.9 and 4.2, which confirms the high level of general awareness among the sample.

**2-8 -Reliability Testing (Cronbach's Alpha)** The reliability coefficient (Cronbach's alpha) was calculated for all three axes, and the values were as follows:

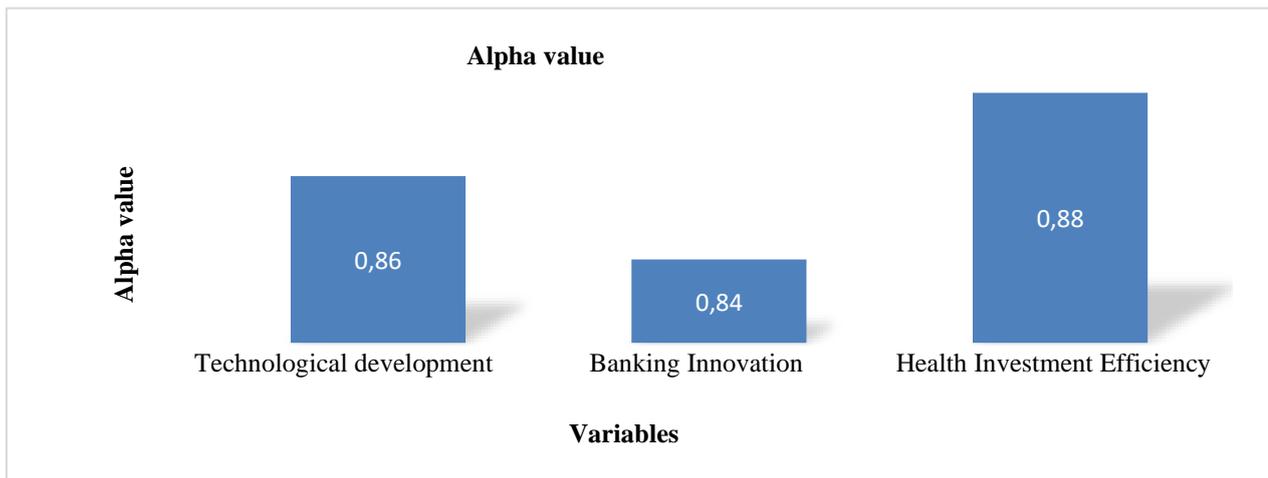
**Table (2) Calculation of Cronbach's Alpha Coefficient**

axis	Number of items	Alpha value	stability level
Technological development	8	0.86	High
Banking innovation	7	0.84	High
Efficient and sound investment	8	0.88	High

Source: Prepared by the researcher using SPSS software

This indicates that the measurement tool used has a high degree of internal consistency, which enhances the reliability of the field data, as shown in the figure below :

**Figure (4) shows the value of (Cronbach's alpha)**



Source: Prepared by the researcher using Excel software

### 3-8-Correlation Analysis (Pearson Correlation)

The results of the correlation analysis showed significant positive relationships between all major variables, as follows:

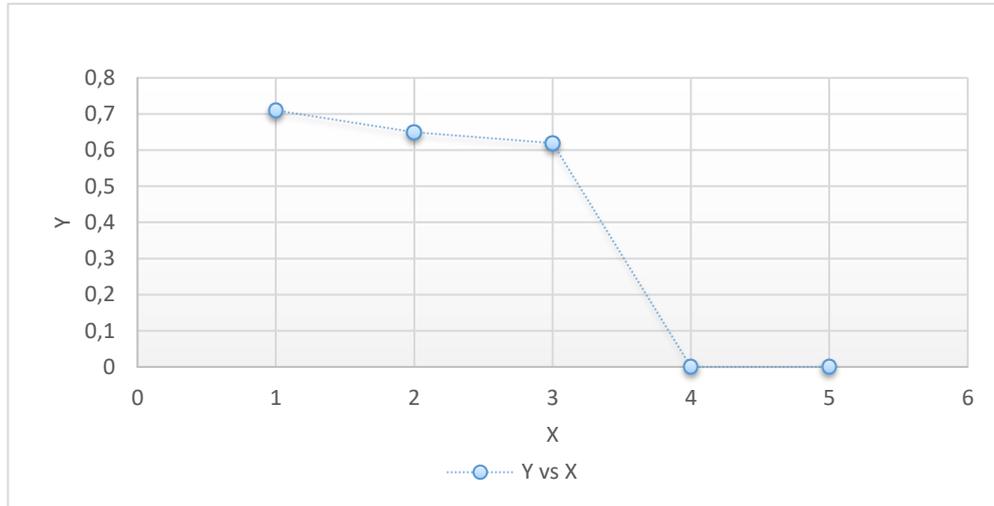
**Table (3) Analysis of Correlation Results**

Interpretation	Statistical significance (Sig)	Correlation coefficient (R)	relationship
Strong and moral	0.000	0.71	Technological development (health investment efficiency)
Medium strong	0.000	0.65	Banking innovation (healthy investment efficiency)
statistically significant relationship	0.000	0.62	Technological development (banking innovation)

Source: Prepared by the researcher using SPSS software

Table (3) indicates that high levels of technological development and banking innovation contribute directly to enhancing the efficiency of sound investment in the institutions studied, as shown in the figure below :

**Figure (5) shows the correlation coefficient between the variables**



Source: Prepared by the researcher using Excel software

Figure (5) reinforces the hypothesis that there is an integration between technological development and banking innovation in raising the efficiency of health investment.

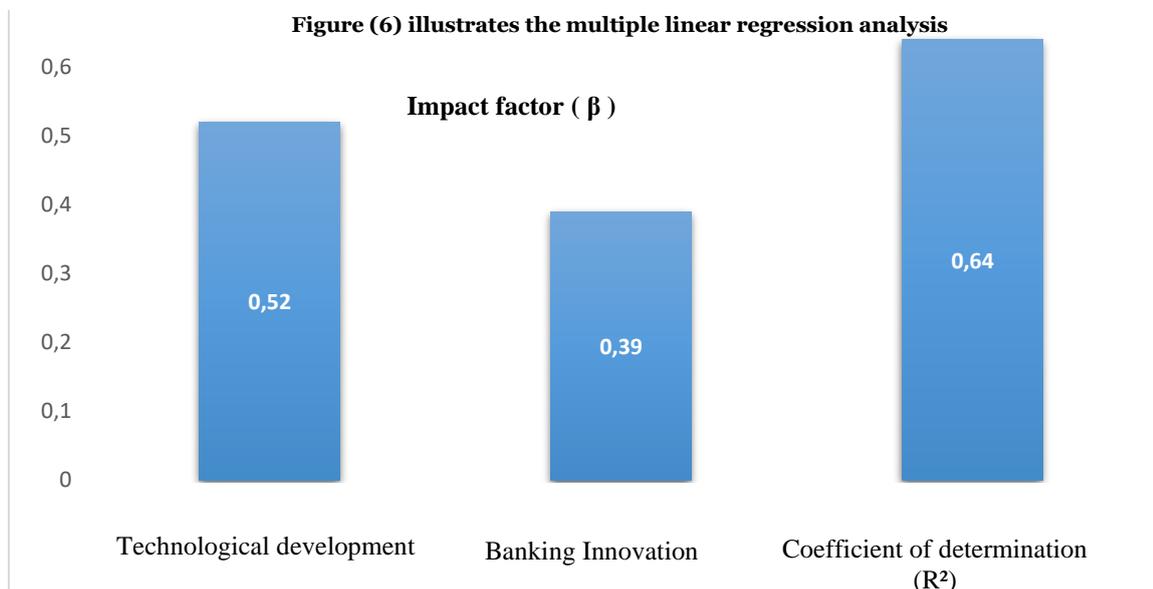
#### 4-8 -Multiple Linear Regression Analysis :

**Table (4) illustrates the multiple linear regression analysis**

Multiple linear regression analysis			
Conclusion	Statistical significance (Sig)	Impact factor $\beta$ (	independent variable
Positive moral effect	0	0.52	Technological development
Positive moral effect	0.001	0.39	Banking Innovation
It explains 64% of the change	—	0.64	Coefficient of determination ( $R^2$ )

Source: Prepared by the researcher using SPSS software

**Figure (6) illustrates the multiple linear regression analysis**



Source: Prepared by the researcher using Excel software

Figure (6) shows that the impact of technological development was the strongest in explaining the variation in investment efficiency.

## 9-Hypothesis analysis using multiple linear regression

The three main hypotheses were tested as follows :

**First hypothesis :** There is a statistically significant relationship between technological development in radiology and ultrasound equipment and the efficiency of health investment in health institutions.

**The result:** The regression results showed that the impact factor  $\beta = 0.52$ , Sig. = 0.000, which means that technological development significantly contributes to raising the efficiency of health investment.

**Conclusion:** The first hypothesis is accepted

**Second hypothesis:** Banking innovation has a positive impact on increasing the efficiency of health investment.

**The result:** The impact factor  $\beta = 0.39$ , Sig. = 0.001, which shows that banking innovation effectively contributes to improving the efficiency of healthy investment.

**Conclusion:** The second hypothesis is accepted.

**Third hypothesis:** The integration of technological development and banking innovation contributes to achieving sustainable investment in healthcare and improving the quality of services.

**The result:** The overall coefficient of determination for the model was  $R^2 = 0.64$ , which explains 64% of the change in health investment efficiency, indicating a substantial combined effect between the two independent variables.

**Conclusion:** The third hypothesis is accepted.

## 10-Analysis:

The field analysis of the survey reveals a positive synergy between technological advancements in medical devices and banking innovation in healthcare financing. This synergy clearly contributes to increased healthcare investment efficiency.

Furthermore, the regression analysis results showed that the two independent variables explain 64% of the variance in healthcare investment efficiency, a statistically high percentage that demonstrates the importance of integrating technology with banking innovation to improve the efficiency of investment activities in the healthcare sector.

## Fourth Axis: Conclusions and Recommendations

### 11- Conclusions:

1. There is a direct and significant relationship between the technological development of medical devices and the efficiency of healthcare investment.
2. Banking innovation represents an important financing tool that contributes to supporting investment trends in the healthcare sector.
3. The integration of technology and banking innovation forms the basis for maximizing the economic value of healthcare projects.
4. Healthcare institutions that adopt data analysis methods and modern technologies achieve higher efficiency in investing their resources.

### 12-Recommendations:

#### ❖ Practical Recommendations

Based on the previous results, a set of practical recommendations can be proposed to improve the efficiency of investment in the Iraqi health sector.

#### A. Regarding the Iraqi Ministry of Health:

1. The necessity of investing in the continuous modernization of medical equipment, especially X-ray and ultrasound machines, to ensure accurate diagnoses and reduce operating costs.
2. Supporting technical training programs for medical personnel to minimize human error and maximize the return on investment from modern technology.
3. Establishing a national database of medical devices and equipment to facilitate their maintenance and development.

#### B. For banks and financial institutions:

1. Develop financing tools specifically designed for the healthcare sector, such as medical equipment leasing and low-interest loans for healthcare institutions.

2. Strengthen partnerships between banks and private hospitals to leverage banking innovation in healthcare investments.
3. Encourage the use of financial technology (FinTech) in financing digital health projects and smart hospitals.

#### C. For healthcare institutions:

1. Adopting integrated digital systems for managing human and material resources enhances operational efficiency.
2. Utilizing data analytics and artificial intelligence to evaluate the financial and investment performance of healthcare projects.

#### D. Future research directions:

1. The scope of the research can be expanded in the future to include healthcare institutions in other governorates to conduct a spatial comparison of levels of technological development and investment.
2. A study on the impact of digital transformation in accounting systems on the efficiency of healthcare investment decisions is proposed.
3. Advanced analytical research using Structural Equation Modeling (SEM) can be conducted to verify causal relationships between variables.
4. The study sample can be expanded to include the private healthcare sector to understand the role of banking innovation in its financing.

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Vol. 11 No. 1 (2026): June

DOI: 10.21070/acopen.11.2026.13760

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