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Assessment of the Quality of Health Services in Private Hospitals in Madinah Region from the Patients' Point of View

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Abstract

The current study aimed to identify the assessment of the quality of health services in private hospitals in Madinah region from the patients' point of view using the descriptive analytical approach. The study sample consisted of (586) patients who visit private hospitals in Madinah. The study tool consisted of a two-part questionnaire: the first is demographic data, while the second consists of the study themes, which involve measuring the effect of tangibility, reliability, responsiveness, quality assurance, and empathy on patients' satisfaction.

The study also sought to show statistically significant differences in the level of service provided to patients that are due to the variables (Gender - Age - Educational level - Nationality) and it attained the following findings:

1. Members of the study sample agreed on the Paragraphs regarding the (tangibility, quality assurance, reliability, and handling) standard theme with a response degree of (agree).
2. Members of the study sample agreed on the Paragraphs regarding the (responsiveness) standard theme at a (medium) response degree.
3. There are statistically significant differences between both males and females in the study themes, through the statistical significance level value of (T)-test for the two independent samples corresponding to each theme separately, which is less than (0.05) in all themes.

4. There are no differences in the themes (responsiveness, handling, and reliability) according to ages, which means there are no differences due to the age variable. This implies that the response to them did not differ according to ages. Nevertheless, we find the statistical significance level value for the (F)-test corresponding to the two themes (tangibility, and quality assurance) less than (0.05), which means that there are statistically significant differences between the means of these themes according to the age variable. This implies that response to these themes varies according to the different age groups for each of the sample members (patients).
5. There are statistically significant differences between the two nationalities of the sample members in the study tool themes, which implies that response to the study tool themes varies according to the nationalities of each member of the sample.

Keywords: Quality of Health Services, Private Hospitals, Madinah Region.

تقييم جودة الخدمات الصحية في المستشفيات الخاصة في منطقة المدينة المنورة من وجهة نظر المرضى

الملخص: هدفت الدراسة الحالية إلى التعرف على تقييم جودة الخدمات الصحية في المستشفيات الخاصة في منطقة المدينة المنورة من وجهة نظر المرضى باستخدام المنهج الوصفي التحليلي. تكونت عينة الدراسة من (586) مريضاً زاروا المستشفيات الخاصة بالمدينة المنورة. تتكون أداة الدراسة من استبيان من جزأين: الأول هو البيانات الديموغرافية ، بينما يتكون الثاني من محاور الدراسة ، والتي تتضمن قياس تأثير الملموسة والموثوقية والاستجابة وضمان الجودة والتعاطف على رضا المرضى.

كما سعت الدراسة إلى إظهار فروق ذات دلالة إحصائية في مستوى الخدمة المقدمة للمرضى تعزى لمتغيرات (الجنس - العمر - المستوى التعليمي - الجنسية) وقد توصلت إلى النتائج التالية:

1. وافق أعضاء عينة الدراسة على الفقرات المتعلقة بالموضوع القياسي (الملموسة ، وضمان الجودة ، والموثوقية ، والتعامل) بدرجة استجابة (موافق).

2. وافق أعضاء عينة الدراسة على الفقرات المتعلقة بالموضوع القياسي (الاستجابة) بدرجة استجابة (متوسطة).

3. توجد فروق ذات دلالة إحصائية بين الذكور والإناث في موضوعات الدراسة ، من خلال قيمة مستوى الدلالة الإحصائية لاختبار (T) للعينتين المستقلتين المقابلتين لكل موضوع على حدة ، وهي أقل من (0.05) في جميع الموضوعات. .

4. لا توجد فروق في المواضيع (الاستجابة ، المعالجة ، الموثوقية) حسب الأعمار ، مما يعني عدم وجود فروق بسبب متغير العمر. وهذا يعني أن الاستجابة لهم لم تختلف باختلاف الأعمار. ومع ذلك نجد أن قيمة مستوى الدلالة الإحصائية لاختبار (F) المطابق للموضوعين (الملموسة وضمان الجودة) أقل من (0.05) مما يعني أن هناك فروق ذات دلالة إحصائية بين متوسطات هذين الموضوعين حسب متغير العمر. وهذا يعني أن الاستجابة لهذه الموضوعات تختلف باختلاف الفئات العمرية لكل فرد من أفراد العينة (المرضى).

5. توجد فروق ذات دلالة إحصائية بين جنسيتي أفراد العينة في محاور أداة الدراسة مما يدل على أن الاستجابة لمواضيع أداة الدراسة تختلف باختلاف جنسيات كل فرد من أفراد العينة.

1. Introduction:

The prevailing changes in the world, developments in many fields, including health, and the spread of numerous epidemics and health crises, have led many governments around the world to seek to modernize, develop and improve health services provided to society members. Since (Covid 19) pandemic and its various variants have posed a challenge to the strength of the health systems of many countries.

The health sector is one of the most important sectors for many countries, due to the significant role it plays in caring for the health of the individual and society, and it proves a country's advancement Saif *et al*., [1]. Many countries have paid attention to the health sector, whether in terms of spending, orientation, development and modernization of infrastructure, application of quality indicators, or through effective monitoring of health activities to ensure the efficiency of this vital facility Durra *et al*., [2].

In this vein, the Saudi Arabian government pays great attention to the health sector, and this is evident in its allocations for health in the general budget during the previous years as well as in the 2022 budget, which indicated its care for the health sector and equipment in the Kingdom. The private health sector is not left out from this development and improvement of medical services to compete with other health sectors and medical centres.

Several studies have indicated the poor health services provided to patients, such as the study of Qasim and Abdul Fattah [3], which indicated there are some challenges and difficulties in health services provided in health clubs in Egypt.

Al-Jariri's study [4] indicated that there is a negative impression among patients about the quality of health services provided to them by private health institutions in Aden province, which has its effect in the (responsiveness, tangibility, and empathy) dimensions in boosting the level of the total quality of health service. Moreover, the findings showed that reliability, trust, and safety dimensions have no effect in boosting the quality level of health services in the surveyed institutions.

Al-Mansouri's study [5] showed that there is a difference between patients assessed in government and private hospitals in the Kingdom of Saudi Arabia regarding the reality of the quality of health care services. However, there is no difference between service providers in these hospitals in the reality of the quality of health care services, and the obstacles facing patients in both sectors are not any different.

The study of Muhammad [6] showed that there is a correlation between the difficulties facing health care services in the Sharia Association of Cairo province and the effectiveness of those services, and that some demographic variables (officials - beneficiaries) are related to the effectiveness of health care services, while some others have nothing to do with that.

The findings of Abbas's study [7] showed that the level of health services was below average in government hospitals in Taiz, Yemen.

The study of Mursi [8] found that the quality level of health services in Al-Sharqiyyah province in the Arab Republic of Egypt before the novel (Covid-19) pandemic was at the average (57.3%). This from the viewpoint of more than half of the surveyed patients, while the quality level of health services during the pandemic was low (63.3%) according to the viewpoint of majority of patients surveyed.

Based on the above, it is clear to the researcher that health services provided, whether in the government or private sectors or health centers, face many difficulties and challenges that may negatively affect their quality, hence, the necessity to conduct a field research to unearth the extent of the quality of health services provided in private hospitals in Madinah.

2. Research Problem:

Having reviewed several studies and research on the quality of health services in medical centres and government and private hospitals in many countries. It has become clear there were some bottlenecks that became evident during the Covid

19 crisis, and its subsequent variants, which led to the collapse of many health systems in many countries. By virtue of my work in the sector and as a supervisor of a medical center in one of the universities, I felt the need to conduct an evaluation study of the quality of health services provided in private hospitals in Madinah.

Based on the foregoing context, the study problem can be determined by answering the following main question:

What is the quality of health services in private hospitals in Madinah from the viewpoint of patients?

3. Research Questions:

To answer the main research question, which is "What is the quality of health services in private hospitals in Madinah from the viewpoint of patients?" the following sub-questions must be addressed first:

1. What is the effect of tangibility on patients' satisfaction with the quality of health services in private hospitals in Madinah?
2. What is the effect of reliability on patients' satisfaction with the quality of health services in private hospitals in Madinah?
3. What is the effect of responsiveness on patients' satisfaction with the quality of health services in private hospitals in Madinah?
4. What is the effect of ensuring patient satisfaction with the quality of health services in private hospitals in Madinah?
5. What is the effect of empathy on patients' satisfaction with the quality of health services in private hospitals in Madinah?
6. Are there statistically significant differences in the level of service provided to patients that are due to (Gender - Age – Educational level - Nationality) variables?

4. Research Objectives:

The current study seeks to achieve the following objectives:

1. Identify the conceptual and philosophical framework for the quality of health services.
2. Identify the extent of the effect of tangibility on patients' satisfaction with the quality of health services in private hospitals in Madinah.
3. Identify the extent of the effect of reliability on patients' satisfaction with regard to the quality of health services in private hospitals in Madinah.
4. Identify the extent of the effect of responsiveness on patients' satisfaction with the quality of health services in private hospitals in Madinah.
5. Identify the extent of the effect of ensuring patients' satisfaction with the quality of health services in private hospitals in Madinah.
6. Identify the extent of the effect of empathy on patients' satisfaction with the quality of health services in private hospitals in Madinah.
7. Identify the statistically significant differences in the level of service provided to patients that are due to (Gender - Age - Educational level - Nationality) variables.

5. Research Importance:

The importance of the current study is represented in two aspects; one is theoretical, while the other is practical as follows:

First: The theoretical importance:

1. This study came to fill the vacuum created by the lack of studies that dealt with measuring the effect of the quality of health services on patients in private hospitals in Madinah.
2. The study may serve as a theoretical reference framework for the quality of health services in health centers and government and private hospitals.
3. It will help to identify the most important standards used by beneficiaries (patients) in evaluating health services.

Second: The practical importance: It is as follows:

1. It may be useful to officials and decision makers in providing reference results that can be adopted in the development of health services in health centers and hospitals.
2. It may be useful to officials and decision makers in identifying the dimensions of health services (tangibility, reliability, responsiveness, assurance, and empathy) based on patient's satisfaction.
3. Its recommendations and suggestions may provide solutions to some health problems that constitute an obstacle to the application of quality in health services.
4. It may be useful to officials in hospitals and health centers to identify weaknesses in the application of the quality of health services through the dimensions of health services (tangibility, reliability, responsiveness, assurance, and empathy) from the patients' point of view.

6. Research Terminology:

Quality of Health Services:

Conventional definition:

Sultan [9, p. 45] defines it as providing quality health services to satisfy the beneficiary according to the latest comprehensive quality standards and indicators, taking into account the ethics, quality of profession and the nature of health service provided.

7. Procedural definition:

It means the application of quality standards in health services provided to beneficiaries in private hospitals in Madinah region, in a manner that makes them feel a high sense of satisfaction.

8. Research boundaries:

Thematic boundary: The study dealt with the quality of health services through the five dimensions of quality: (tangibility - reliability - responsiveness - assurance - empathy) according to Parasuraman, *et al*., [10] scale.

Time boundary: The study tool was applied during 2022.

Spatial boundary: (Saudi German Hospital – Al-Hayat National Hospital - Madinah National Hospital – Al-Muwasat Hospital). These four hospitals have been chosen based on my first-hand experience as the best private hospitals in Madinah with many problems related to the field of research.

Human boundary: They are the patients who received health services from the selected study sample.

9. Literature Background:

In the quest to achieve the objectives of the current study, the researcher reviewed some previous works related to the study and its variables. The findings of related research are briefly presented as follows:

Evaluation of Health Clubs, Qasim and Abdul-Fattah [3]

The study aimed at evaluating health clubs by exploring them and the programs they offer. The researchers designed a questionnaire and used the descriptive approach with a sample of (90) health practitioners, whose ages range between (28-48) years. The findings showed that many individuals lack enough information about the nature of health clubs. Moreover, the location and distance of a health club are among the most important considerations for joining it, and it strengthens social relations.

Measuring the quality of health services (a field study) of the opinions of a sample of clients "patients" dealing with private hospitals in Aden Province, Al-Jariri [4]

This study aimed to find out how clients (patients) and users of health services evaluate the quality of services provided by private hospitals in Aden Province. The researcher developed a questionnaire, compiled the necessary information and distributed it to a sample of clients (patients) numbering (181). The study attained some findings, the most important of which are:

1. Clients (patients) have a negative impression about the quality of health services provided to them by private health institutions.
2. The dimensions (responsiveness, tangibility, and empathy) have effect in increasing the level of the total quality of health service. The findings showed that reliability, trust, and safety have no effect in increasing the level of quality of health services in the surveyed institutions.

Based on the study findings, some recommendations were made, the most important of which are:

1. Institutions need to pay attention to training and development programs that focus on building the skills of dealing with clients (patients) and responding to their demands.
2. Private health institutions need to use modern marketing methods in dealing with their clients, and take advantage of scientific, administrative, and marketing centers to implement modern marketing trends.
3. Continuously improve the health services provided to patients to increase the level of confidence and reassurance on their part, as well as to continue to communicate with them to know their suggestions and complaints regarding the services provided by building an information system in health facilities that supports continuous quality improvement.

Quality of Health Care Services in Hospitals in the Kingdom of Saudi Arabia, a Comparative Study between the Government and Private Sectors, Al-Mansouri [5].

The study aimed to determine the reality of the quality of health care services in government and private hospitals in the Kingdom of Saudi Arabia, to identify the factors impeding achieving the quality of these services, and to reach a set of proposals to improve the quality of health care services in these hospitals. The study concluded that there is a difference between patients in government hospitals and those in private hospitals regarding the reality of the quality of health care services. Meanwhile, there is no difference between service providers in government and private hospitals in this regard, and the obstacles facing patients in government hospitals are not different from those facing patients in private hospitals.

The Effectiveness of Health Care Services in Civil Societies "An Applied Study on Sharia Association in Cairo Province", Muhammad [6].

The study aimed to determine the effectiveness of health care services offered in Sharia Association centers by assessing the hospital's ability to provide health services to its beneficiaries, the extent to which these services can satisfy the needs of patients, the speed rate of procedures for obtaining the service, and the availability of human relations between workers and their families. It also sought to identify the obstacles limiting the effectiveness of health care services and come about a set of planning indicators that can contribute to overcoming them.

It concluded that healthcare services in the Shariah Society are highly effective, that there is a correlation between the difficulties facing healthcare services in the Shariah Society and the effectiveness of those services, and that some demographic variables (officials - beneficiaries) have to do with the effectiveness of health care services while some others have nothing to do with them.

Measuring the quality of health services in government hospitals, an applied study on government hospitals in Taiz city, Yemen, from the beneficiary's point of view, Abbas [7].

The study aimed to identify the methods of measuring the quality of health services in government hospitals from the beneficiary's point of view using the basic standards for measuring service quality (tangibility - assurance - quality - responsiveness - handling - reliability), and their relationship to the health procedures adopted in government hospitals in Taiz, Yemen. The researcher used the questionnaire as a tool for collecting data and the responses were based on Likert five-point scale. He attained several findings, including that the level of health services was below average in government hospitals. He presented a set of recommendations aimed at improving the level of health services in government hospitals, in the city of Taiz.

The quality of health services provided to rural people, in Al-Sharqiyyah Province during Corona pandemic, Mursi [8].

The study aimed to identify and test the significance of differences in the quality level of health services provided to rural people and their dimensions, each independent on the other, before and during the novel covid-19 pandemic from the viewpoint of both patients and medical staff. It was conducted using the social survey method and applied to the health units in Saud and Samakin Al-Sharq. The sample of patients was 150 respondents, while the sample of medical staff was 35 respondents. The data was collected using the personal interview questionnaire form during the period from the end of July until the end of August 2020, and was analyzed and presented using frequencies, percentages, arithmetic mean, Cronbach's alpha stability coefficient, and "t" test for two correlated samples. The research attained a set of findings the most important of which are: The level of quality of health services before the novel covid-19 pandemic was at the average according to the viewpoint of more than half of the patients surveyed, which was 57.3%. While the level of quality of health services during the novel covid-19

pandemic was low according to the viewpoint of the majority of patients surveyed, which was 63.3%. The level of quality of health services before the novel covid-19 pandemic was high according to the viewpoint of less than half of the medical staff surveyed, which was 48.6%. While the level of quality of health services during the novel covid-19 pandemic was at the average according to the viewpoint of more than half of the medical staff surveyed, which was 54.3%. It was also found that there were significant differences before and during the novel covid-19 pandemic at a significant level of 0.01 regarding the quality level of health services provided to rural people from the viewpoint of the study sample of patients, in favor of the period before the novel covid-19 pandemic with the highest arithmetic mean of (98.97). There are also significant differences before and during the novel covid-19 pandemic at a significant level of 0.01 with regard to the quality level of health services provided to rural people from the viewpoint of the medical staff in the study sample, in favor of the period before the novel covid-19 pandemic with the highest arithmetic mean of (116.34).

The Evolution of Health Concern in Sports Clubs in Victoria, Dobbin son *et.al* [11].

The study aimed to discuss the extent to which sports activities are concerned with health aspects, how health agencies actualize their control measures, know the levels of health development in sports clubs for five factors (Smoking – Sun Screening - Healthy food – No-Smoking campaigns) to prevent sports injuries. The researchers used the descriptive approach, for a sample of (1932) sports clubs, and concluded on the diversity of concerns shown to health policies and activities within sports clubs. The sports clubs pay attention to campaigns for the prevention of drug addiction and alcohol, where about (31%) of sports clubs work to prevent smoking, about 81% of them apply sun screen factors to protect against the sunshine, 86% of them showed interest in diving, while 81% were interested in rescuing the injured. The findings showed that sports clubs pay attention to applying health factors under the supervision of health agencies. Sports clubs need support and supervision from health agencies.

10. Notes on previous studies:

It is evident from the presentation of previous studies that:

In terms of methodology:

Some studies aimed to measure the quality of health services in health clubs and civil associations (NGOs), such as the study of Dobbin son et.al [11], Qasim and Abdul-Fattah [3], and Muhammad [6]. Yet, some studies aimed at measuring the quality of health services in private hospitals, such as Al-Jariri's study [4]. Some studies aimed at measuring the quality of health services in private and government hospitals, such as Mansouri's study [5], while some aimed at measuring the quality of health services in government hospitals only, such as the study of Mursi [8] and Abbas [7].

In terms of the tool used:

Some studies used the questionnaire as a tool for data collection, such as the study of Dobbin son et.al [11], Qasim and Abdul Fattah [3], Al-Jariri [4], Mursi [8], Mansouri [5] Abbas [7]. As for the method used, some studies used the descriptive approach such as, Qasim and Abdul Fattah [3], Al-Jariri [4], Mansouri [5], Muhammad [6], Abbas [7], Mursi [8].

In terms of the findings:

Some studies concluded that the quality of health services is below average, such as Al-Jariri [4], Abbas [7], Mursi [8], and some studies indicated that the quality of health services is above average, such as Muhammad [6].

In terms of the advantages:

The researcher has taken advantage of the previous studies in determining the objective, choosing the appropriate method, the sample and its number and choosing the measuring tool.

However, this study is distinguished from the previous studies in terms of the study population and period. Moreover, based on the researcher's knowledge, this is the only study that deals with private hospitals in Madinah, and it seeks to evaluate health services in these hospitals in 2022.

Theoretical framework:

The theoretical framework deals with the quality of health services concept, and its dimensions, with an indication of the areas where quality management is applied in health institutions.

Definition of quality as a concept:

Owing to the multiple aspects and dimensions of quality as a concept, writers and interested persons have varying opinions about developing an accurate, unified, and comprehensive definition for the concept. Some opine that the expression "quality" refers to the management's ability to easily produce or provide a service that can meet the needs of consumers and customers. Largely, Johnson's definition of quality agrees with these definitions, whereby he has defined quality as the ability to achieve the desires of consumers in a way that conforms to their expectations and achieves their complete satisfaction with the good or service provided Zain Al-Din, [12].

Al-Bakri [13] defined it as a philosophy based on the process of integrating the organization's operations and related functions to attain a distinct level of quality.

It was also defined as a set of organizational programs aimed at regulating the level of satiation of the customer by adhering to the principles of continuous improvement of operations Al-Muhsin [14].

Al-Qurashi [15] defines it as creating a culture of performance excellence, where managers and employees work continuously and diligently to achieve consumer

expectations and conduct work accurately right from the beginning. While achieving better quality, effectively and in the shortest time.

The researcher points out that the concept of quality is an Islamic approach even before modern theories and opinions of thinkers and writers, and it means executing work with quality and accuracy, and in accordance with some internationally recognized practices and indicators. Several quality theories have emerged that define its various dimensions. Deeming is considered the pioneer of quality based on a set of principles that he developed.

The concept of health services:

Health services refer to a set of health activities, programs and mechanisms provided by medical institutions to patients Madhat [16, p. 591].

It is also defined as: All services provided to satisfy the health needs or desires of the health service applicant Al-Anazi [17, p. 33].

Measuring the quality of health services:

The in-depth study of the concept of quality in services led to giving it a new name (SERVQUAL) that represents a merger between (Service) and (Quality). It is a multi-dimensional scale for measuring quality, which consists of five dimensions (tangibility, reliability, responsiveness, security, and empathy). This scale is based on knowledge of the gap between what the customer perceives about the service and what he expects.

However, there is the most common approach in measuring service quality, which depends on the judgment of consumers benefiting from the service. That is, (quality = performance) and it is called (SERVPERF), where the views of service beneficiaries are surveyed according to the five-point Likert scale ranging between “strongly agree” and “strongly disagree”, in order to determine the ratio of the

effect of each dimension to the total value of the service quality Al-Bakri [13:8] Al-Shumaimiri [18].

This scale developed by Cronin and Taylor [19], which focuses on and evaluates the services actually provided based on the users' viewpoint, will be used. Many foreign and Arab researchers have accepted it as the appropriate scale; because ease of application and simplicity in measurement, as well as its high level of reliability and realism distinguish it, which reinstate customer expectations and his perceptions of the level of service quality.

This scale consists of the following dimensions of the quality of health services: Al-Mansouri, [5]:

1. Reliability: It is the ability of the health service provider to respect its appointments and to perform the service accurately and reliably.
2. Tangibility: It includes the medical technology used, the external appearance of the health facility, and the various facilities it has.
3. Responsiveness: It is the desire of the health service provider to help and provide medical services to patients in a timely manner, considering their health conditions and giving priority to emergency cases.
4. Security and Assurance: It means that the health service is free from danger and doubt.
5. Empathy: means the show of spirit of friendship and concern for the patients to make them feel their importance the desire to provide the curative services they needed and give them care and attention.

In light of the foregoing, it can be said that these dimensions can be used to judge the quality of health services provided in health centers, units and hospitals, and to measure the extent of beneficiary's satisfaction with those services.

- **A comprehensive view that defines quality dimensions in the health field, Niaz [20].**

A- Effectiveness of Care:

Effectiveness refers to the degree to which an objective has been achieved, the extent the desired results (outcome) of care have been achieved, and the degree at which the developed strategy has succeeded in achieving the objectives. It further reflects the extent to which work has been done in the right manner. In order to understand what this dimension means; the following question must be answered: Did the measure or intervention yield the desired results?" In this way, effectiveness is measured by the ratio of results to inputs.

B- Efficiency of Service Delivery:

It is the ratio of service outputs to the costs of producing those services. It means the balanced use of (human, financial and material) resources to provide the best health care for the patient and the community, and to achieve the greatest benefit within the available resources. In other words, it means providing the best possible health care with optimal investment of available resources through minimization of costs by providing the necessary and correct services and avoiding unnecessary or inappropriate services.

C- Technical Competence:

This dimension is important in the field of curative and non-curative services, as it includes skills related to preventive care, diagnosis, treatment, and provision of health advice. In the non-curative area (such as administration), it requires supervision, training and problem-solving skills and it refers to the level functions achieved by health workers and facilities conform to the expected technical quality (i.e. conform to standards). This technical ability is measured by the extent to which the technical performance conforms to the required standards and specifications, for example:

- Efficiency of medical staff: This means the ability to provide efficiently curative, preventive, and advisory services.

- Efficiency of administrative staff: This means the ability to supervise, train and solve work-related problems.
- Efficiency of the auxiliary staff: This means the ability to perform technical work efficiently and with competence.

The difference in technical ability ranges from minor deviations from the procedures to be adopted, to lack of technical ability, which may lead to major errors that may endanger the lives of patients.

D- Continuity:

It is one of the necessities of quality assurance, and it means that the provided health services are not interrupted, as well as the provision of the service by the same service provider during the period of care (whenever appropriate), appropriate referral in a timely manner and communication between service providers. It may also imply keeping correct medical files so that the patient can always see the same doctor. Discontinuity leads to a low quality level, which may hinder the provision of health care in the correct manner or increase the costs of providing these services.

E - Safety:

Minimizing as much as possible the risk of exposure to injuries resulting from medical profession practice or resulting from being inside the health institution, or risks related to health services for both the service provider and the recipient. For instance, in the process of blood transfusion, preventive means must be available to prevent infection with hepatitis or HIV for both the health service provider and the recipient.

F- Accessibility:

Ease of access to services in the health field means that health care services are not restricted by any geographical, economic, social, cultural, organizational or

linguistic barriers, or to the extent that services are not restricted by those barriers. This is one of the most important quality dimensions, because the difficulty of accessing health services can sometimes prevent access to basic medical services such as vaccinations, which lead to the occurrence of health problems in the future, such as increasing the rate of morbidity, which could have been avoided. Easy access to services can be clarified as follows:

- **Geographical access**: Where the following matters are taken into consideration: the availability of means of transportation to reach the service, the distance from the health facility, the time required to reach health services and the natural obstacles that prevent the patient from accessing that service.
- **Social (cultural) access:** It refers to the acceptance of the health service provided within the framework of the patient's cultural values, beliefs, and orientations. For example, the necessary periodic medical examinations according to age groups.
- **Physical or economic access**: It refers to the ability of the service recipient to pay for the health service.
- **Linguistic access:** It means the existence of linguistic communication between the service provider and the recipient to ensure that the patient's actual need is known and provided to him.
- **Institutional or organizational access**: It means the extent to which services are organized in a way that suits their beneficiaries. This includes several things such as working hours, appointment system, waiting periods and the method of providing the service.

G - Interpersonal relations:

This dimension relates to the interaction between the clients of the health institution and members of the health team and administrative staff. It implies the existence of trust, respect, confidentiality, diplomacy, experiences, understanding, listening and communication between service providers and their beneficiaries, because standing good relationships between the parties may lead to the success

of the health service and responsiveness of patients to medical instructions. Such relationships are achieved through good listening, mutual respect, confidentiality, and acceptable courtesy.

H – Appropriateness: It is to follow the correct procedure for the situation at work.

I- Timeliness: It means doing the work at the right time.

J- Choice: It means the possibility for the service recipient to choose the service provider, the plan, the guarantee, or treatment when it is appropriate.

K - Physical Infrastructure & Comfort:

It means services that are not related to medical procedures, but which increase patients' turnout and return to the same health service provider. This includes the physical appearance and cleanliness of health facilities, amenities, privacy, and other important aspects cherished by service beneficiaries. It also includes the external appearance of the building, amenities, and entertainment, ensuring privacy, and providing means of entertainment for clients, such as educational medical programs using projectors, teaching aids, and books (pp. 34-38).

Based on the previous context, the researcher indicates that despite the multiple approaches to measuring and evaluating service quality, there is consensus among researchers in this field that there are two main models for measuring service quality. The first is attributed to Parasuraman et al., [10] and it is based on customers' expectations of the level of service and their perceptions of the level of performance of the service actually provided, and then determining the gap or conformity between these expectations and perceptions, using the five dimensions that represent the earlier referred manifestations of service quality. This model for measuring service quality is called the gap scale or SERVQUAL scale. The second model is called the SERVPERF or Actual Service Performance Model and was

developed by Cronin and Taylor [19]. It is considered a modified model from the previous one and it focuses on measuring the actual performance of the service provided to the customer, given that the quality of service is expressed as a type of trend.

11. Methodology and Procedures:

Preamble:

This includes the methodology adopted by the researcher and the procedures followed in preparing this study. At the beginning of the chapter, there will be a preamble explaining its contents. Then, it will address the methodology, sources of data collection, study population, sample size, study tool and the obstacles faced by the researcher while preparing the study.

Research Methodology:

The descriptive analysis approach was used, which is one of the most common scientific research methods. It is defined as a research method that deals with existing events, phenomena and practices that are available for study and measurement as they are without the researcher's intervention in their course, but he can interact with, describe, and analyze them. This research uses two types of data sources:

Primary sources: The field study and the data and information related to the study it contains. This is represented in the questionnaire as the main study tool, which was distributed to the sample members. Then the questionnaires were collated and analyzed using the appropriate statistical tests, in order to reach the valuable significances that support the subject of research.

Secondary sources: Searching and reading in different websites and digital libraries to collect different research references including books, periodicals, articles, reports, research studies, references and Arab and foreign references

related to the subject of assessing the quality of health services in private hospitals in Madinah from the viewpoint of patients.

Research population and sample:

The study population includes all patients of private hospitals in Madinah. In view of the large size of the research community and lack of a framework to control it, the non-random sample method was used, employing a soft sampling method to target the sample members. This is how the sample size was (586) individuals.

Research tool:

The main research tool is a questionnaire that was prepared as follows:

1. Reading and reviewing a number of previous studies and research articles related to the research topic, in order to determine the questionnaire themes. The researcher made use of several studies such as Qasim and Abdul -Fattah [3], Al-Jariri [4], Al-Mansouri [5], Muhammad [6], Abbas [7], and Mursi [8] while preparing the study questionnaire.
2. Formulating the paragraphs of the questionnaire that fall under each theme, according to the topic of the theme.
3. Drafting the questionnaire's prototype to be used in collecting data and information.
4. Presenting the questionnaire to the supervisor and members of the refereeing committee, in order to obtain advice and guidance for amendment.
5. Converting the questionnaire from paper to electronic form, using (Google Drive) as a way to facilitate the process of distributing it and communicating with all members of the study sample later.
6. Distributing the questionnaire to a simple segment of the sample members that numbered (34) patients in private hospitals in Madinah, representing (15%) of the total population, in order to collect the data necessary for the study and to ensure the validity and quality of the questionnaire by finding

the coefficients of (stability and internal consistency). The questionnaire was divided into two main sections as stated below:

Section 1: Identifying some personal and demographic characteristics of patients (gender, age, nationality, educational level).

Section 2 expresses the themes of the study tool, where the tool consists of (34) questions distributed over five main themes as follows:

Theme 1: Tangibility standard and it consists of (10) paragraphs.

Theme 2: Quality assurance standard, and it consists of (9) paragraphs.

Theme 3: Responsiveness standard, and it consists of (5) paragraphs.

Theme 4: Handling standard and it consists of (5) paragraphs.

Theme 5: Reliability standard and it consists of (5) paragraphs.

Modification of the study tool:

The five-point Likert scale was adopted to answer the paragraphs of the second section. Each paragraph consisted of five response options, where the score "5" means (strongly agree), and the score "1" means (strongly disagree) according to Table (1).

Table 1: Classification of the 5-point Likert Scale (relative weight)

Response	Grade	Range
Strongly agree	5	From 4.20 to 5
Agree	4	From 3.40 to less than 4.20
Neutral	3	From 2.60 to less than 3.40
Disagree	2	From 1.80 to less than 2.60
Strongly disagree	1	From 1 to less than 1.80

The weighted arithmetic means were calculated for each of the paragraphs of the study tool and compared with the range in the previous table, and the corresponding answer was given for the range within which the average of the Paragraph falls.

Validity and reliability of the study tool:

Validity of the questionnaire means that its questions measure what it was designed for, and the researcher has validated the questionnaire using the (face validity) method.

7-3 Face validity:

The researcher presented the questionnaire to the supervisor and a group of referees specialized in the field of performance evaluation, who in turn provided advice, guidance, and amendments as necessary. The reseracher acted upon the recommendations of the supervisor and referees before the questionnaire appeared in its final form.

Internal consistency validity (Construct validity):

To calculate the internal consistency validity, Pearson's correlation coefficients were calculated for the relationship between each paragraph and the degree of the theme to which it belongs, and the results came as in the following tables:

Table (2). Internal Consistency Validity of the first theme: Tangibility

S/No	Correlation Coefficient	S/No	Correlation Coefficient
1	(**).784	6	(**).805
2	(**).625	7	(**).821
3	(**).794	8	(**).813
4	(**).797	9	(**).760

(*) Significant at (0.01) - (**) Significant at (0.05)

From the above table showing the results of the internal consistency validity of the first theme: Tangibility, by calculating the Pearson correlation coefficient between

each paragraph and the total score of the theme, we find that all correlation coefficients were positive ranging between (0.521 - 0.821), which are high positive values, and all of them are statistically significant at (0.01). This indicates that the first theme is internally consistent. Therefore, the paragraphs measure what they were designed for.

Table (3). Internal Consistency Validity of the second theme: Quality Assurance.

S/No.	Correlation Coefficient	S/No	Correlation Coefficient
1	(**).811	6	(**).694
2	(**).803	7	(**).686
3	(**).878	8	(**).846
4	(**).781	9	(**).817
5	(**).518		

(*) Significant at (0.01)

From the above table showing the results of the internal consistency validity of the second theme: Quality Assurance, by calculating the Pearson correlation coefficient between each paragraph and the total score of the theme. We find that all correlation coefficients were positive ranging between (0.518 - 0.878), which are positive values and all of them are high and statistically significant at (0.01). This indicates the second theme is internally consistent, and therefore the paragraphs measure what they were designed for.

Table (4). Internal Consistency Validity of the third theme: Responsiveness

S/No.	Correlation Coefficient
1	(**).905
2	(**).871

3	(**).842
4	(**).859
5	(**).892

(**) Significant at (0.01)

From the above table showing the results of the internal consistency validity of the third theme: Responsiveness, by calculating the Pearson correlation coefficient between each paragraph and the total score of the theme, we find that all correlation coefficients were positive ranging between (0.842 - 0.905), which are positive values and all of them are high, and statistically significant at (0.01). This indicates the third theme is internally consistent, and therefore the paragraphs measure what they were designed for.

Table (5). The Internal Consistency Validity for the fourth theme: Handling.

S/No	Correlation Coefficient
1	(**).898
2	(**).894
3	(**).766
4	(**).868
5	(**).804

(**) Significant at (0.01)

From the above table showing the results of the internal consistency validity of the fourth theme: Handling, by calculating the Pearson correlation coefficient between each paragraph and the total score of the theme, we find that all correlation coefficients were positive ranging between (0.766 - 0.898), which are positive values and all of them are high, and statistically significant at (0.01). This indicates the fourth theme is internally consistent, and therefore the paragraphs measure what they were designed for.

Table (6). Internal consistency validity of the fifth theme: Reliability

S/No.	Correlation Coefficient
1	(**).785
2	(**).792
3	(**).871
4	(**).798
5	(**).865

(**) Significant at (0.01)

From the table above showing the results of the internal consistency validity of the fifth theme: Reliability, by calculating the Pearson correlation coefficient between each paragraph and the total score of the theme, we find that all correlation coefficients were positive ranging between (0.785 - 0.871), which are positive values and all of them are high, and statistically significant at (0.01). This indicates the fifth theme is internally consistent. Therefore, the paragraphs measure what they were designed for.

Reliability of the study tool:

To calculate the reliability coefficient of the tool, Cronbach's alpha coefficients were used, and the results were as follows:

Table (3-4). Values of Cronbach's alpha reliability coefficients for the themes of the study tool

Themes	Number of Paragraphs	Cronbach's alpha

Tangibility	**10**	**0.914**
Quality Assurance	**9**	**0.877**
Responsiveness	**5**	**0.921**
Handling	**5**	**0.900**
Reliability	**3**	**0.877**
The tool as a whole	**34**	**0.967**

The table above shows Cronbach's alpha reliability coefficients for the study standards. We find that Cronbach's alpha coefficient for the first theme, which consists of (10) paragraphs, is (0.914), for the second theme, which consists of (9) paragraphs, it is (0.887), for the third theme, which consists of (5) paragraphs, it is (0921), for the fourth theme, which consists of (5) paragraphs it is (0.900), and finally for the fifth theme, which consists of (5) paragraphs, it is (0.877). However, for the tool as a whole it is (0.967). We note that all these values are high, which indicates a high stability of the study tool.

Statistical tools and processes used:

Data of this study will be analyzed using the Statistical Package for Social Science (SPSS) version (24), and the following statistical processes and tests will be employed:

1. Frequencies and percentages to describe the research sample according to the primary variables.
2. Pearson correlation coefficient to verify the validity of the internal structure of the study tool.
3. Cronbach's alpha coefficient to validate the stability of the study tool.

4. Arithmetic mean and standard deviation to answer the study questions.
5. One-way analysis of variance (ANOVA) and t-test for independent samples to study the differences in the themes of the study tool according to the initial variables of the sample members.

12. Research findings and its interpretation

This section includes a presentation of the research findings, based on the statistical analysis of the data collected using the questionnaire, verification of the study's objectives and answering the questions that were raised.

Personal data of the study sample

Table (7) Distribution of the study sample according to personal data

Variable	Variable Categories	Number	Percentage %
Gender	Male	518	88.4
	Female	68	11.6
Age	From 15 years to less than 25 years	50	8.5
	From 25 years to less than 40 years	304	51.9
	From 40 years and above.	232	39.6
Nationality	Saudi	569	97.1
	Non-Saudi	17	2.9
Educational level	Elementary	1	0.2
	Intermediate	14	2.4
	Secondary	75	12.8
	College and above	496	84.6
Total		586	100

The above table shows the percentages and frequencies for the distribution of the sample members according to personal data. With regard to gender, we find that most patients are males with a percentage of (88.4%), while the percentage of females is (11.6%) of the total patients participating in this study.

With regard to ages, it was found that the majority of patients participating in the study were in the age group (from 25 years to less than 25 years) with a percentage of (51.9%), then the age group (from 40 years and over) with a percentage of (39.6%), and finally (from 15 years to less than 25 years) with a percentage of (8.5%).

With regard to nationality, it was found that the majority of patients were Saudis with a percentage of (97.1%), while the percentage of non-Saudis was (2.9%).

Finally, as for the educational levels of patients, they were mostly college students or post college students, with a percentage of (84.6%), then secondary with a

percentage of (12.8%), then intermediate with a percentage of (2.4%), and finally primary with a percentage of (0.2%).

Answer to the research the questions:

Tangibility:

Table (8) Arithmetic means and standard deviations of the responses of the sample members about the tangibility standard

Paragraph	Arithmetic mean	Standard deviation	Degree of approval	Rating
The hospital uses modern machines and technologies in the medical examination process.	3.72	0.94	Agree	2
The hospital enjoys cleanliness in all its facilities.	3.75	0.98	Agree	1
The hospital environment consists of green spaces that contribute to the comfort of the inpatients.	2.78	1.38	Neutral	10
The hospital has modern ambulances that contain all medical supplies and first aid.	3.55	1.10	Agree	5
The hospital provides modern and advanced beds.	3.41	1.04	Agree	7
The hospital provides clean mattresses and bedcovers.	3.65	1.04	Agree	3
The hospital has a high ventilation system in its various facilities.	3.43	1.09	Agree	6
The hospital has modern laboratory equipment.	3.64	1.03	Neutral	4
Within the hospital, there are car parks suitable for the number of visitors.	2.84	1.39	Neutral	9

The hospital has a café or the like that serves all beverages and services.	3.34	1.13	Neutral	8
The theme as a whole	3.41	1.11	Agree	

The above table includes the arithmetic means, standard deviations, and degrees of approval of the sample members regarding the tangibility standard. We find that the overall average is (3.41 out of 5) and it falls within the fourth category of the five-point Likert scale (3.4-4.2), which means that patients approve the tangibility standard.

Based on the arithmetic means and standard deviations, we find that the paragraphs are arranged from highest to lowest according to the arithmetic mean as follows:

The paragraph (the hospital enjoys cleanliness with all its facilities) is at the top of the hierach of the tangibility standard paragraphs with a mean of (3.75) and a high degree of approval, then the paragraph (the hospital uses machines and modern technologies in the medical examination process) with a mean of (3.72) and a high degree of approval. In the third order is the paragraph (the hospital provides clean mattresses and bedcovers) with a mean of (3.65) and a high degree of approval, in the fourth place is the paragraph (the hospital contains modern laboratory equipment) with a mean of (3.64) and a high degree of approval, then the paragraph (the hospital has modern ambulances that contain all medical supplies and first aid) with a mean of (3.55) and a high degree of approval. In the sixth position is the paragraph (the hospital has a high ventilation system in its various facilities) with a mean of (3.43) and a high degree of approval, in the seventh position is the paragraph (the hospital provides modern and advanced beds) with a mean of (3.41) and a high degree of approval, in the eighth position came the paragraph (The hospital contains a café or the like that serves all beverages and services) with a mean of (3.34) and a high degree of approval. In the ninth position is the paragraph (Within the hospital, there are car parks suitable for the number of visitors) with a mean of (2.84) and a medium degree of approval, and finally the

paragraph (The hospital environment consists of green spaces that contribute to the comfort of the inpatients) with a mean of (2.78) and a medium degree of approval.

Table (9): Arithmetic means and standard deviations of the responses of the sample members about the quality assurance standard.

Paragraph	Arithmetic mean	Standard deviation	Degree of approval	Rating
I feel reassured and secure when receiving medical examination and treatment.	3.50	1.09	Agree	4
The hospital staff is highly qualified and skilled in handling patients.	3.45	1.10	Agree	5
The hospital has skilled doctors for all specialties.	3.30	1.11	Neutral	7
The hospital provides rare specialties.	2.83	1.11	Agree	9
The patient prefers to visit private hospitals due to the speedy procedures.	4.31	0.91	Strongly agree	1
The hospital provides all first aid for emergency cases.	3.81	0.93	Agree	2
The hospital is keen to provide medications of all kinds in its pharmacy.	3.54	1.15	Agree	3
The hospital provides high quality health service.	3.41	1.08	Agree	6
The medical staff is available in all specialties around the clock.	3.10	1.20	Neutral	8
The theme as a whole	3.47	1.08	Agree	

The above table is the arithmetic means and standard deviations of patients' responses about the quality assurance standard. From the overall average of (3.47 out of 5), it falls within the fourth category of the five-point Likert scale, which means that patients agree to a large extent with the quality assurance standard.

Based on the arithmetic means and standard deviations, the paragraphs of this standard were arranged in descending order. So, we find that the paragraph (The patient prefers to visit private hospitals due to the speedy procedures) is at the top of the ladder with an arithmetic mean of (4.31) and a very high degree of approval, followed by the second paragraph (The hospital provides all first aid for emergency

cases) with an arithmetic mean of (3.81) and a high degree of approval. In the third position is the paragraph (The hospital is keen to provide medications of all kinds in its pharmacy) with an arithmetic mean of (3.54) and a high degree of approval. In the fourth place is the paragraph (I feel reassured and secure when receiving medical examination and treatment) with an arithmetic mean of (3.50) and a high degree of approval. This is followed by the paragraph (The hospital staff is highly qualified and skilled in handling patients) in the fifth position with an arithmetic mean of (3.45) and a high degree of approval, then in sixth position is the paragraph (The hospital provides high quality health service) with an arithmetic mean of (3.41) and a high degree of approval. The paragraph ranked seventh is (The hospital has skilled doctors for all specialties) with an arithmetic mean of (3.30) and a medium degree of approval. In the eighth position is the paragraph (The medical staff is available in all specialties around the clock) with an arithmetic mean of (3.10) and an average degree of approval, and finally, in the ninth place, is the paragraph (The hospital provides rare specialties) with an arithmetic mean of (2.83) and an average degree of approval.

Table (10) Arithmetic means and standard deviations of the responses of the sample members about the responsiveness standard.

Paragraph	Arithmetic mean	Standard deviation	Degree of approval	Rating
The hospital's healthcare meets the patient's purpose.	3.46	1.00	Agree	3
The medical staff is skilled.	3.54	0.91	Agree	2
The medical staff has good reputation and high morals.	3.62	0.93	Agree	1
Consultant doctors are available around the clock.	2.86	1.17	Neutral	5
There are qualified staff to deal with emergencies, accidents, and critical cases.	3.38	1.03	Neutral	4
The theme as a whole	3.37	1.01	Neutral	

The above table is the arithmetic means and standard deviations of the patients' responses about the responsiveness standard. We find that the overall average of the theme as whole is (3.37 out of 5) and it falls within the third category of the five-point Likert standard, which means that patients agree to a moderate degree with the responsiveness standard.

Based on the arithmetic means and standard deviations, the paragraphs were arranged in descending order, starting with the one with the largest mean and ending with the one with the smallest mean. We find that the paragraph (The medical staff has good reputation and high morals) has an arithmetic mean of (3.62) and a high degree of approval, then followed by the paragraph (The medical staff is skilled) with an arithmetic mean of (3.54) and a high degree of approval. In the third position is the paragraph (The hospital's healthcare meets the patient's purpose) with an arithmetic mean of (3.46) and a high degree of approval. In the fifth position came the paragraph (There are qualified staff to deal with emergencies, accidents, and critical cases) with an arithmetic mean of (3.38) and average degree of approval, and finally came the paragraph (Consultant doctors

are available around the clock) with an arithmetic mean of (2.86) and a medium degree of approval.

Table (11) Arithmetic means and standard deviations of the responses of the sample members about the handling standard

Paragraph	Arithmetic mean	Standard deviation	Degree of approval	Rating
The medical staff handles patients with respect and professionalism.	3.66	0.98	Agree	3
The nursing staff handles patients with kindness and respect.	3.72	0.99	Agree	1
The reception staff handles patients with courtesy and respect.	3.71	1.01	Agree	2
The doctors give enough time for medical examination and diagnosis.	3.58	0.98	Agree	4
The hospital administration seeks to overcome all obstacles facing the visitors.	3.43	1.03	Agree	5
The theme as a whole	3.62	1.00	Agree	

The above table is the arithmetic means and standard deviations of the patients' responses about the handling standard. We find that the overall average of the theme as a whole was (3.62 out of 5), which falls within the fourth category of the five-year Likert standard, which means that patients agree with the handling standard.

Based on the arithmetic means and standard deviations, the paragraphs were arranged in descending order, starting from the largest mean and ending with the paragraph with the smallest mean. At the top of the hierachy is the paragraph (The nursing staff handles patients with kindness and respect) with an arithmetic mean

of (3.72) and a high degree of approval. This is followed by the paragraph (The reception staff handles patients with courtesy and respect) with an arithmetic mean of (3.71) and a high degree of approval, then the paragraph (The medical staff handles patients with respect and professionalism) with an arithmetic mean of (3.66) and a high degree of approval. In the fourth position came the paragraph (The doctors give enough time for medical examination and diagnosis.) with an arithmetic mean of (3.58) and a high degree of approval. In the fifth and last position is the paragraph (The hospital administration seeks to overcome all obstacles facing the visitors) with an arithmetic mean of (3.43) and a high degree of approval.

Table (12) Arithmetic means and standard deviations of the responses of the sample members about the reliability standard

Paragraph	Arithmetic mean	Standard deviation	Degree of approval	Rating
The hospital provides medical and curative services quickly and correctly.	3.45	0.98	Agree	4
The hospital keeps all information regarding patients.	3.99	0.81	Agree	1
The hospital uses accurate scheduling for attending to the hospital's inpatients.	3.65	0.91	Agree	3
The hospital is committed to strict confidentiality with regard to the information of visitors.	3.98	0.85	Agree	2
The hospital administration is committed to transparency in dealing with visitors.	3.43	1.13	Agree	5

The theme as a whole	3.70	0.94	Agree	

The above table shows the arithmetic means, standard deviations, and degrees of approval of the responses of the sample members about the reliability standard. We find that the overall average of the theme as a whole was (3.70 out of 5) and it falls within the fourth category of the five-point Likert standard, which means that patients agree to a large extent with the reliability standard.

Based on the arithmetic means and standard deviations, the paragraphs were arranged in descending order, starting with the paragraph with the largest mean and ending with the paragraph with the smallest mean. We find that the paragraph (The hospital keeps all information regarding patients) comes at the top of the hierachy with an arithmetic mean of (3.99) and a high degree of approval, then the paragraph (The hospital is committed to strict confidentiality with regard to the information of visitors). In the third position is the paragraph (The hospital uses accurate scheduling for attending to the hospital's inpatients) with an arithmetic mean of (3.65) and a high degree of approval. In the fourth position came the paragraph (The hospital provides medical and curative services quickly and correctly) with an arithmetic mean of (3.45) and a high degree of approval, and finally the paragraph (The hospital administration is committed to transparency in dealing with visitors) came with a high degree of approval.

Comparison between standards:

Table No. (13) shows a comparison between the five standards according to the arithmetic means and standard deviations:

Standards	Arithmetic means	Standard deviation	Response
Tangibility	3.41	1.11	Agree
Quality Assurance	3.47	1.08	Agree
Responsiveness	3.37	1.01	Neutral
Handling	3.62	1.00	Agree
Reliability	3.70	0.94	Agree

The tool as a whole (all standards)	3.51	1.03	Agree

The above table is a comparison between the five standards according to the arithmetic means. We find that the reliability standard is one of the best standards that achieves patient satisfaction in Madinah region, with the largest arithmetic mean of (3.70), followed by the handling standard with an arithmetic mean of (3.62), followed by the quality assurance standard with an arithmetic mean of (3.47), then the tangibility standard with an arithmetic mean of (3.41) and finally the response standard with an arithmetic mean of (3.37) as the least standard that achieves patients' satisfaction in Madinah region. The following figure compares these standards according to the arithmetic means.

From the overall arithmetic mean of all the standards, it is clear that there is a general satisfaction with health services in private hospitals in Madinah region. This is proven by the value of the overall arithmetic mean of all standards, which is (3.51) and it corresponds to the degree of approval to a large extent.

Differences in the arithmetic means of the study tool themes according to personal variables:

To find out the differences between the arithmetic means of the study tool themes according to gender variables, the ANOVA and the independent sample t-test were used as shown in the following tables:

Table (14) shows the differences between the arithmetic means of the study tool themes according to the gender variable

Themes	Gender	Sample	Mean	Standard deviation	(T) value	Significance level	Interpretation
Tangibility	Male	518	34.8263	8.03214	5.872	0.000	Significant
	Female	68	28.6324	8.19702			
	Male	518	31.5888	7.15583	3.065	0.003	Significant

Quality Assurance	Female	68	28.7353	7.22685			
Responsiveness	Male	518	16.9961	4.36311	2.452	0.016	Significant
	Female	68	15.7941	3.71989			
Handling	Male	518	18.3185	4.08953	3.295	0.001	Significant
	Female	68	16.4118	4.53588			
Reliability	Male	518	18.6313	3.92201	3.231	0.002	Significant
	Female	68	17.4412	2.68430			

The results of the above table showed that there is a statistically significant difference between both males and females in the study themes, through the value of the level of statistical significance of (T)- test for the two independent samples corresponding to each theme separately, which is less than (0.05) in all themes. This means that the response to each theme differs according to gender (male /female) and through the corresponding arithmetic means for both males and females. We also find that these differences were in favor of males (i.e., the arithmetic mean of males is greater than that of females).

Table (15) Differences between the means of the study tool themes according to the age variable

Themes	**Sources of variance**	**Sum of squares**	**Degrees of freedom**	**Average Sum of Squares**	**(F) Value**	**Significance level**	**Interpretation**
Tangibility	Between groups	1510.442	2	755.221	11.391	.000	Significant
	Within groups	38651.785	583	66.298			
	Total	40162.227	585				
Quality Assurance	Between groups	547.096	2	273.548	5.331	.005	Significant
	Within groups	29914.994	583	51.312			
	Total	30462.090	585				
Responsiveness	Between groups	59.059	2	29.529	1.594	.204	Not significant

	Within groups	10796.900	583	18.520			
	Total	10855.959	585				
Handling	Between groups	85.223	2	42.612	2.446	.088	Not significant
	Within groups	10158.233	583	17.424			
	Total	10243.456	585				
Reliability	Between groups	77.113	2	38.556	2.662	.071	Not significant
	Within groups	8443.360	583	14.483			
	Total	8520.473	585				

The above table shows the differences between the arithmetic means of the study tool themes according to the ages of patients. We find that there are no differences in the themes (Responsiveness, Handling and Reliability) according to ages, where we find that the value of the statistical significance level of (F)-test corresponding to these themes is greater than (0.05). This means that there are no differences due to the age variable. This implies that the responses to them do not differ according to different age groups. However, we find the value of the level of the statistical significance of (F) test corresponding to the two themes (tangibility and quality assurance) less than (0.05), which means that there are statistically significant differences between the averages of these themes due to the age variable. The response to these themes varies according to the age groups of each member of the sample (patients).

To know the direction of these differences, the least significant difference (LSD) test was used, as shown in the following table:

Table (16) Results of the least significant difference test in the themes of tangibility, assurance and quality assurance

Themes	Age (a)	Age (b)	Difference between the two means (a-b)	Significance level
Tangibility	From 15 years to less than 25 years	From 25 years to less than 40 years	(*)4.72539	000.
		From 40 years and above	2.07397	103.
	From 25 years to less than 40 years	From 15 years to less than 25 years	(*)4.72539-	000.
		From 40 years and above	(*)2.65143-	000.
	From 40 years and above	From 15 years to less than 25 years	2.07397-	103.
		From 25 years to less than 40 years	(*)2.65143	000.
Quality Assurance	From 15 years to less than 25 years	From 25 years to less than 40 years	(*)3.51500	001.
		From 40 years and above	(*)2.67448	017.
	From 25 years to less than 40 years	From 15 years to less than 25 years	(*)3.51500-	001.

		From 40 years and above	84052.-	179.
	From 40 years .and over	From 15 years to less than 25 years	(*)2.67448-	017.
		From 25 years to less than 40 years	84052.	179.

The table above shows the results of the least significant difference (LSD) test. It indicates that the differences in the "Tangibility" theme were in favor of the age groups (From 15 years to less than 25 years and 40 years and above). In the quality assurance theme, the differences were between each of (From 15 years to less than 25 years) on one hand and (From 25 years to less than 40 years and above) on the other hand and in favor of the age group (From 15 years to less than 25 years).

Nationality: Table (17) Differences between the nationalities of the sample members in the study tool themes

Themes	**Nationality**	**Sample**	**Mean**	**Standard deviation**	**(T) value**	**Significance level**	**Interpretation**
Tangibility	Saudi	569	33.9279	8.23746	-3.196	0.005	Significant
	Non-Saudi	17	40.1176	7.85718			
Quality Assurance	Saudi	569	31.1072	7.18352	-3.161	0.006	Significant
	Non-Saudi	17	36.2941	6.64986			
Responsiveness	Saudi	569	16.7522	4.30404	-5.234	0.000	Significant
	Non-Saudi	17	20.3529	2.73727			
Handling	Saudi	569	17.9982	4.16072	-3.742	0.002	Significant
	Non-Saudi	17	21.4118	3.69220			
Reliability	Saudi	569	18.3954	3.79724	-4.538	0.000	Significant
	Non-Saudi	17	21.7647	2.99018			

The above table shows the differences between the average of the study tool themes according to the nationality variable (Saudi and non-Saudi) through the value of the statistical significance level (T)-test for the two independent samples corresponding to all themes less than (0.05), which means that there are statistically significant differences between the two nationalities of the sample members in the themes of the study tool. That is, the answer to the themes of the study tool varies according to the two nationalities of members of the sample, and through the value of the corresponding averages for each nationality, we find that the average of the non-Saudi is greater than the average of the Saudis, which means that the differences are in favor of the non-Saudis. The following figure illustrates these differences:

Table (18) Differences between the arithmetic means of educational levels of the sample members in the study tool themes

Themes	**Sources of variance**	**Sum of squares**	**Degrees of freedom**	**Average Sum of Squares**	**(F) value**	**Significance level**	**Interpretation**
Tangibility	Between groups	1012.120	3	337.373	5.015	002.	Significant
	Within groups	39150.106	582	67.268			
	Total	40162.227	585				
Quality Assurance	Between groups	516.353	3	172.118	3.345	019.	Significant
	Within groups	29945.738	582	51.453			
	Total	30462.090	585				
Responsiveness	Between groups	199.795	3	66.598	3.637	013.	Significant
	Within groups	10656.164	582	18.310			
	Total	10855.959	585				
Handling	Between groups	88.808	3	29.603	1.697	167.	Not significant

	Within groups	10154.648	582	17.448			
	Total	10243.456	585				
Reliability	Between groups	41.634	3	13.878	953.	415.	Not significant
	Within groups	8478.838	582	14.568			
	Total	8520.473	585				

The above table shows the results of the differences between the means of the study tool themes according to the educational levels variable of the sample members. We find that the value of the statistical significance level of (F)-test corresponding to the themes (Handling and Reliability) is greater than (0.05), which means that there are no statistically significant differences between the educational levels of the sample members in these two themes. This implies that the response to them does not differ according to the educational level. However, the value of the corresponding themes (Tangibility, Quality Assurance, Responsiveness) is less than (0.05), which implies that the answer to these themes vary according to the educational level of each member of the sample. To know the direction of the differences, the least significant difference test (LSD) was used as shown in the table below:

Table (19): The least significant difference test for the (Tangibility, Quality Assurance, Responsiveness) themes according to the educational level variable

Themes	**Educational level (a)**	**Educational level (b)**	**Difference between the two means (a-b)**	**Significance level**
Tangibility	Secondary	College and above	3.26616(*)	0.001
Quality Assurance	Secondary	College and above	1.82608(*)	0.041
	College and above	Intermediate	-4.74505(*)	0.019

	Intermediate	Primary	5.44231(*)	0.028
Responsiveness	Secondary	College and above	1.17131(*)	0.028
	College and above	Intermediate	-2.98669(*)	0.013

Based on the results of the least significant difference (LSD) according to the educational levels of the sample members, we find that the difference was between two levels (secondary, and college and above) and it was in favor of the secondary level with respect to the "tangibility" theme. The difference between the (college and above, and intermediate) levels was in favor of the intermediate, and between (intermediate and primary) it was in favor of the intermediate with respect to the "quality assurance" theme. Regarding the "responsiveness" theme, the difference between (secondary, and college and above) levels was in favor of the secondary level, and between (college and above, and intermediate) it was in favor of the intermediate level.

Discussion of Research Findings

The findings showed that there is a great level of patient satisfaction with tangibility in private hospitals in Madinah region, in several aspects. The most important of which is cleanliness, the use of modern mechanisms and techniques in the process of providing clean mattresses, bedcovers, and modern laboratory equipment, as well as the availability of ambulances with the latest equipment, and because the hospitals have a high ventilation system in their various facilities and provide modern and advanced beds. Private hospitals have cafés that provide all services and beverages. In addition, they have car parks suitable for the number of patients, as well as green spaces that contribute to the comfort of inpatients and visitors.

The findings of the analysis indicated that there is a large degree of satisfaction with the quality assurance standard in private hospitals in Madinah region, due to the speedy procedures. Availability of all first aid for emergency cases, availability of all medications in their pharmacies, the comfort and reassurance patients feel

when receiving medical examination and treatment. The highly skilled staff handling patients in these hospitals, the high-quality health service provided by highly skilled doctors and other medical staff who are available around the clock, in addition to the availability of some rare specialties.

The findings further showed that there is a moderate degree of satisfaction by the patients with private hospitals in Madinah with the responsiveness standard, due to the good reputation, high morals, and high skills of the medical staff largely. It was also found that the health care available in these hospitals meets the needs of patients, that the health staff are qualified to handle emergency patients, accidents and critical cases, and that the consultant doctors are available around the clock to meet the needs of patients and visitors.

The findings indicated that there is a high degree of satisfaction with the handling standard by patients and visitors of private hospitals in the Madinah region in several respects. Including the fact that nursing staff handles patients and visitors with much kindness, respect, and diplomacy, the medical staff handles patients with respect and professionalism in these hospitals, the doctors give enough time for medical examination and diagnosis, and there is also an effort by the hospitals administrations to overcome all obstacles and difficulties facing patients and visitors.

The findings also showed that patients and visitors of private hospitals in Madinah region are satisfied with the reliability standard in several respects, the most important of which is that private hospitals keep and observe strict confidentiality of all personal information and data related to patients. There is also an accurate scheduling for attending to the patients and inpatients in these hospitals, hospitals provide medical and curative services quickly and correctly, and there is transparency in handling patients and visitors.

In view of these findings, there is a general satisfaction with the medical services provided by private hospitals in the Madinah region.

The findings also showed that there are statistically significant differences between the arithmetic means of the themes and standards. According to the personal

variables: (gender) in all themes, (age) in the "tangibility and quality assurance" themes in favor of the age group (from 15 to less than 25 years), and the (nationality) variable in all themes in favor of non-Saudis. The (educational levels) variable in the "tangibility" theme in favor of the secondary level, quality assurance theme in favor of the secondary and intermediate, and responsiveness theme in favor of the secondary and intermediate levels.

13. Summary of Findings:

4. Approval of the study sample of the paragraphs of the (Tangibility) theme came with an overall average score of (3.41 out of 5), which falls within the fourth category according to the five-point Likert scale (3.4-4.2). This means that patients agree with the tangibility standard, at a consent level of (agree).
5. The patients' responses to the quality assurance standard came with an overall score of (3.47 out of 5), which falls within the fourth category of the five-point Likert scale. This means that patients largely agree with the quality assurance standard.
6. Approval of the study sample regarding the paragraphs of the (Responsiveness) theme came with an overall average score of (3.37 out of 5), which falls within the third category according to Likert's five-point scale. This means that patients agree with the responsiveness standard, at a (medium) degree.
7. Approval of the study sample regarding the paragraphs of the (Reliability) theme came with an overall average score of (3.70 out of 5), which falls within the fourth category according to Likert's five-point scale. This implies that patients agree mostly with the reliability standard, with a consent level of (Agree).
8. Approval of the study sample regarding the paragraphs of the (Handling) theme came with an overall average of (3.62 out of 5) as a whole, which falls within the fourth category of the five-point Likert scale implies that patients agree with the handling standard.

9. There is a statistically significant difference between both males and females in the study themes, through the value of the level of statistical significance of (T)-test for the two independent samples corresponding to each theme separately, which we find less than (0.05) on all themes. This means that the response to each theme differs according to gender (male/female).
10. There are no statistically significant differences in the (Responsiveness, Handling, and Reliability) themes due to the ages, whereby the value of the statistical significance level of (F)-test corresponding to these themes is greater than (0.05), and this implies that there are no differences due to age variable. In other words, response to them does not differ according to age groups of sample members. However, we find that the value of the statistical significance level of (F)-test corresponding to the two themes (Tangibility, and Quality Assurance) is less than (0.05), which means that there are statistically significant differences between the means of these themes due to the age variable. This implies that the responses to these themes vary according to the different age groups for each sample member (The patients).
11. There are statistically significant differences between the two nationalities of the sample members in the study tool themes, and this implies that the responses to these themes differ according to the nationality of each sample member.

14. Recommendations:

12. The necessity of paying attention to the dimensions of the quality of health services in the health sector in general and private hospitals in the Kingdom of Saudi Arabia in particular.
13. “Quality culture” must be disseminated and in activated private hospitals.
3. The necessity of educating the staff of health centers and private hospitals on the importance of providing health services with accuracy, speed, and honesty, and reducing the percentage of error in handling visitors and clients.

4. The necessity of training private hospitals staff on handling beneficiary complaints and striving to minimize them.
5. The necessity of increasing scientifically and practically qualified medical cadres in private hospitals.
6. Increasing the number of beds in order to meet emergencies and sudden societal crises.
7. The necessity of having qualified medical staff in the emergency department, while reducing and digitizing administrative procedures.
8. All systems within private hospitals must be automated, to reduce waiting times.
9. There should be accuracy in diagnosis, and provision of a group of specialized consultants in all specialties.
9. The need to adhere to speed and accuracy in completing medical transactions and emergency medical insurance cases.
10. The necessity of providing all local and imported medicines and their various alternative medications in the hospital pharmacy to meet emergencies and crises.

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A Note on Generalization of Totally Projective Modules

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Abstract: In this paper we extend the notion of totally projective QTAG- modules as almost totally projective QTAG-modules and prove that for an h- reduced QTAG-module M with a submodule N such that M/N is countably generated; if N is almost totally projective module then M is also almost totally projective.

Keywords: QTAG Modules, h-reduced QTAG-module, totally projective module, nice submodule, 2020 Mathematics Subject Classification: 20K10.

عنوان البحث: ملاحظة حول تعميم وحدات الإسقاط الكلي

الملخص: في هذا البحث ، نوسع مفهوم وحدات QTAG الإسقاطية تمامًا كوحدات QTAG إسقاطيه بالكامل تقريبًا ونثبت أنه بالنسبة للوحدة M المختصرة من QTAG مع وحدة فرعية N بحيث يتم إنشاء M / N بشكل عددي ؛ إذا كانت N عبارة عن وحدة إسقاطيه بالكامل تقريبًا

1 Introduction

Many concepts for groups like purity, projectivity, injectivity, height etc. have been generalized for modules. To obtain results of groups which are not true for modules either conditions have been applied on modules or upon the underlying rings. We imposed the condition on modules that every finitely generated submodule of any homomorphic image of the module is a direct sum of uniserial modules while the rings are associative with unity. After these conditions, many elegant results of groups can be proved for QTAG-modules which are not true in general. This paper take the motivation for generalization from the results in the paper [1].

The study of QTAG-modules was initiated by Singh [8]. Khan [5], Mehdi [7] etc. worked a lot on these modules etc. They studied different notions and structures of QTAG-modules, developed the theory of these modules by introducing several notions and investigated some interesting properties and characterized them. Yet there is much to explore.

A module M over an associative ring R with unity is a QTAG-module if every finitely generated submodule of any homomorphic image of M is a direct sum of uniserial modules [9]. All the rings R considered here are associative with unity and modules M are until QTAG-modules. An element x ∈ M is uniform, if xR is a non-zero uniform (hence uniserial) module and for any R-module M with a unique composition series, d(M) denotes its composition length. For a uniform element x ∈ M, e(x) = d(xR) and $H_M(x) = \sup\left\{d\left(\frac{yR}{xR}\right) \mid y \in M, x \in yR \text{ and } y \text{ uniform }\right\}$ are the exponent and height of x in M, respectively. $H_k(M)$ denotes the submodule of M generated by the elements of height at least k and $H^k(M)$ is the submodule of M generated by the elements of exponents at most k. M is h-divisible if $M = M^1 = \bigcap_{k=0}^{\infty} H_k(M)$[5] and it is h-reduced if it does not contain any h-divisible submodule. In other words it is free from the elements of infinite height. A submodule N of a QTAG-module M is a nice submodule if every nonzero coset $a + N$ is proper with respect to N i.e. for every nonzero $a + N$ there is an element $b \in N$ such that $H_M(a + b) = H_{M/N}(a + N)$. A family $\mathcal{N}$ of submodules of M is called a nice system in M if

(i) $0 \in \mathcal{N}$; (ii) If $\{N_i\}_{i\in I}$ is any subset of $\mathcal{N}$, then $\Sigma_I N_i \in \mathcal{N}$; (iii) Given any $N \in \mathcal{N}$ and any countable subset X of M, there exists $K \in \mathcal{N}$ containing $N \cup X$, such that K/N is countably generated [7].

Every submodule in a nice system is nice submodule. A h-reduced $QTAG$ module M is called totally projective if it has a nice system. Notations and terminology are follows from [3].

2 Main Results

Totally projective modules were defined by Mehdi [7]. Hasan [4], etc. worked a lot on these modules. Here we start with the generalization of these modules as almost totally projective QTAG-modules.

Definition 1 A h-reduced QTAG-module M is almost totally projective if it has a collection A of nice submodules such that

(i) $\{0\} \in \mathcal{A}$;
(ii) $\mathcal{A}$ is closed with respect to unions of ascending chains and
(iii) if N is a countably generated submodule of M then there exists $K \in \mathcal{A}$ such that $N \subseteq K$ and K is also countably generated.

First we will establish some elementary results related to almost totally projective QTAG-modules. We start with the following:

Proposition 1 Suppose K is an isotype submodule of a QTAG-module M. Then K is almost totally projective provided that K is separable in M.

Proof Let K be an almost totally projective QTAG-module and suppose to the contrary that it is not separable in M. Then, there exists $m \in M$ such that, for each countably generated submodules T of K, we can find an element $k^* \in K$ such that $H(m + k^*) > H(m + t)$ | for every $t \in T$. Therefore we can find an ascending chain

$$0 = K_0 \subseteq K_1 \subseteq \cdots \subseteq K_n \subseteq \cdots$$

of countably generated submodules K_n of K such that $K_n \in \mathcal{A}$ for each n and such that the following condition holds.

(*) For every finite n, there exists $k_{n+1} \in K_{n+1}$ such that $H(m + k_{n+1}) > H(m + k)$ for all $k \in K_n$.

Now set $K_\omega = \cup_{n<\omega_0} K_n$ and observe that K_ω is a countably generated submodule of K belonging to $\mathcal{A}$. Since K_ω is countably generated, there exists $k^* \in K$ such that $H(m + t) < H(m + k^*)$ for every $t \in K_\omega$. Since K_ω is nice in K, there exists $k' \in K_\omega$ such that $H_K(k^* - t) \leqslant H_K(k^* - k')$ for all $t \in K_\omega$. Moreover, since $k' \in K_n$ for some n, there exists by condition $(\star)$ an element $k'' \in K_{n+1}$ such that $H(m + k'') < H(m + k^*)$. So, we now have $H_K(k^* - k'') \leq H_K(k^* - k')$. Since K is isotype in M, we have $H(m + k') < H\big((m + k^*) - (m + k'')\big) = H(k^* - k'') = H_K(k^* - k'') \leq H_K(k^* - k') = H(k^* - k') = H(m + k')$ which leads to a contradiction and proving our desired result.

The next two propositions as analogs of the corresponding well-known results for totally projective modules.

Proposition 2 If $H_\sigma(M)$ and $M/H_\sigma(M)$ are almost totally projective, for any ordinal σ then M is also almost totally projective.

Proof We know that a submodule K is a nice submodule of M if and only if $pH_\sigma(K)$ is a nice submodule of $H_\sigma(K)$ and $K + H_\sigma(M)/H_\sigma(M)$ is a nice submodule of $M/H_\sigma(M)$. Hence, the properties that satisfy the three conditions for a family of nice submodules to be almost totally projective for both $H_\sigma(M)$ and $M/H_\sigma(M)$ also satisfy the same conditions for the module M.

Proposition 3: The arbitrary direct sums of almost totally projective QTAGmodules are almost totally projective.

Proof: Suppose $M = \oplus_{i\in I} M_i$. As it is well known, if $K = \oplus_{i\in I} K_i$ with $K_i \subseteq M_i$ for all $i \in I$, then K is a nice submodule of M if and only if K_i is a nice subgroup of M_i

for each $i \in I$. Hence, the three properties of almost totally projectives modules satisfying by M_i ensures that M will certainly satifies the same and hence the result follows.

We proceed by proving our main theorems. Before doing that, we need the following useful technicality on niceness, which can be of general interest as well.

Lemma 1: Let M be a $QTAG$-module with a nice submodule N. If K is a $QTAG$-module such that $K \cap M \subseteq N$, then $N + K$ is nice in $M + K$.

Proof: We apply transfinite induction on the ordinals, to prove that $H_\alpha(M + K) \subseteq H_\alpha(M) + K + N$ for every ordinal α.

If α is not a limit ordinal then by using induction we express

$$\begin{aligned} H_\alpha(M + K) &= H_1(H_{\alpha-1}(M + K)) = H_1(H_{\alpha-1}(M) + K + N) \\ &\subseteq H_1(H_{\alpha-1}(M)) + K + N = H_\alpha(M) + K + N. \end{aligned}$$

If α is a limit ordinal then again by transfinite induction we have

$$H_\alpha(M + K) = \bigcap_{\beta<\alpha} H_\beta(M + K) \subseteq \bigcap_{\beta<\alpha} \big(H_\beta(M) + K + N\big).$$

Let $u \in \bigcap_{\beta<\alpha}\big(H_\beta(M) + K + N\big)$. Then $u = x_\rho + y_1 + z_1 = x_\sigma + y_2 + z_2 = \cdots$ where $x_\rho \in H_\rho(M), y_1 \in K, z_1 \in N; x_\sigma \in H_\sigma(M), y_2 \in K, z_2 \in N, \rho < \sigma < \alpha$. Since $M \cap K \subseteq N, y_2 \in y_1 + N, x_\rho + z_1 \in \bigcap_{\beta<\alpha}\big(N + H_\beta(M)\big) = N + H_\alpha(M)$ because N is nice in M. Therefore $u \in H_\alpha(M) + K + N$, thus $\bigcap_{\beta<\alpha}\big(H_\beta(M) + K + N\big) \subseteq H_\alpha(M) + K + N$
Now we may conclude that, for an ordinal γ

$$\begin{aligned} \bigcap_{\gamma<\delta} \big(N + K + H_\gamma(M + K)\big) &= \bigcap_{\gamma<\delta} \big(N + K + H_\gamma(M)\big) \\ &= N + K + H_\delta(M) \\ &= N + K + H_\delta(M + K). \end{aligned}$$

Therefore $N + K$ is nice in $M + K$.

Now we are able to prove the following:

Theorem 1: Let M be a h-reduced $QTAG$-module with a submodule N such that M/N is countably generated. If N is almost totally projective module then M is also almost totally projective.

Proof: We may express $M = N + K$ where K is countably generated. Since N is almost totally projective it has a collection $\mathcal{B}$ of nice submodules satisfying the three conditions of Definition 1. Thus there exists a countably generated submodule T of $N \in \mathcal{B}$ such that $N \cap K \subseteq T$. Now $K + T$ is again countably generated and we may write $(K + T) \cap N = T + K \cap N = T$. Also $\frac{M}{K+T} = \frac{N+K}{K+T} \simeq \frac{N}{N\cap(K+T)} = \frac{N}{T}$. Since T is countably generated, N is almost totally projective where $\mathcal{F} = \{P/T \mid T \subseteq P \in \mathcal{B}\}$ is the collection of nice submodules of N/T. By the same argument $\frac{M}{K+T}$ has a collection $\mathcal{A}$ of nice submodules $\frac{Q}{K+T}$ such that the three conditions are satisfied and it is almost totally projective. Now we put $\mathcal{A}' = \{0\} \cup \left\{Q \subseteq M \mid \frac{Q}{K+T} \in \mathcal{A}\right\}$.

Now $\frac{Q}{K+T}$ is nice in $\frac{M}{K+T}$ and by Lemma 1, $K + T$ is nice in $K + N = M$ then by [6], Q is a nice submodule of M. Now $\{0\} \in \mathcal{A}'$ by definition. Consider $\{Q_i\}_{i\in I}$ the ascending chain of members of $\mathcal{A}'$. Since $\left\{\frac{Q_i}{K+T}\right\}$ is also an ascending chain for all indices i, we find that $\bigcup_{i\in I}\left(\frac{Q_i}{K+T}\right) = \frac{\bigcup_{i\in I} Q_i}{K+T} \in \mathcal{A}$, hence $\bigcup Q_i \in \mathcal{A}'$. Now suppose S is a countably generated submodule of M. Thus $\frac{S+K+T}{K+T} \simeq \frac{S}{S\cap(K+T)}$ is a countably generated submodule of $\frac{M}{K+T}$ and there is $\frac{Q}{K+T} \in \mathcal{A}$ such that $\frac{S+K+T}{K+T} \subseteq \frac{Q}{K+T}$ where $\frac{Q}{K+T}$ is countably generated. Therefore $S + K + T \subseteq Q$, hence $S \subseteq Q$ where $Q \in \mathcal{A}'$ and Q is countably generated, so is $K + T$ and all the conditions are satisfied.

Theorem 2: Let M be a h-reduced $QTAG$-module with a nice countably generated submodule N such that M/N is almost totally projective. Then M is almost totally projective.

Proof: Let M/N be an almost totally projective module. Now M/N has a collection $\mathcal{B}$ of nice submodules satisfying the three conditions. Consider $\mathcal{A} = \left\{K \subseteq M \mid \frac{K}{N} \in \mathcal{B}\right\} \cup \{0\}$.

If $0 \neq K \in \mathcal{A}$ then $K/N \in \mathcal{B}$ and hence K/N is nice inM/N. Since N is nice in M by [6], K is nice in M. Therefore $\mathcal{A}$ is the collection of nice submodules of M such that$\{0\} \in \mathcal{A}$.

Let $\{T_i\}_{i\in I}$ be an ascending chain of nonzero modules, belonging to $\mathcal{A}$. Now $\left\{\frac{T_i}{N}\right\}$ is also an ascending chain of modules belonging to $\mathcal{B}$. Now $\bigcup_{i\in I}\left(\frac{T_i}{N}\right) = \frac{\bigcup_{i\in I} T_i}{N} \in \mathcal{B}$. Therefore $\bigcup T_i \in \mathcal{A}$ as $\bigcup T_i \subseteq M$ and the second condition is satisfied. Let Q be an arbitrary countably generated submodule of M. Now $\frac{Q+N}{N} \simeq \frac{Q}{Q\cap N}$ is a countably generated submodule of M/N and there is $P/N \in \mathcal{B}$ such that $\frac{Q+N}{N} \subseteq P/N$ and P/N is countably generated. Therefore $P \in \mathcal{A}, Q + N \subseteq P \subseteq \mathcal{A}$, hence $Q \subseteq P$ and P is countably generated, so is N. When $Q \subseteq N$, we may take $P = N$. Since $N \in \mathcal{A}$ and N is countably generated.

Following is the immediate consequence of the above results.

Corollary 1 Let N be a submodule of a h-reduced $QTAG$-module M with length $< \sigma$. If N is separable and the direct sum of countably generated modules such that M/N is countably generated or N is countably generated and nice in M such that M/N is also separable and a direct sum of countably generated modules then M is also separable and the direct sum of countably generated modules.

We end this short communication by posting an open problem as follows:

Open Problem: Under what suitable restrictions on a submodule N, if we suppose M/N be an almost totally projective QTAG-module, which leads to a necessary and sufficient condition for M to be almost totally projective QTAG-module.

Acknowledgement

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DEVELOPMENT OF AN INTELLIGENT SYSTEM FOR MODELING

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Abstract: To have insight into several model challenges, it is important to utilize artificial networks in models. Various research papers have been published about these artificial intelligence techniques. None of these publications addresses problems of the computation of estimates and forecasts for solving real-world data and models from estimated data.

Aims/Objectives: The objectives of this research are (1)To develop an artificial neural method for solving problems (2)The development of techniques to solve complex problems (3)The computation of estimates and forecasts for real-world data (4)The development of models from estimated data. The techniques investigated in this research are important and necessary for solving vague complex, and bogus problems in artificial intelligence. Consequently, a thorough study comprising techniques applied in this study is used for comparisons and utilized to identify a reliable method for modeling and forecasting problems. This research investigates different procedures utilized in artificial intelligence for modeling an efficient decision-making process.

Methodology/approach: Past studies of methods were utilized for this study. The methods applied in this paper include collecting data from REDcap, an online data collection tool. This was determined on the training dataset (70%) and evaluated on testing data (30%). The model is developed using the neural network, binary analysis, supervised learning classifier, and result determination.

Results/finding: The evaluation of results is done by comparing their performance using accuracy metrics. The model implementation was done using MATLAB programming language. The data was processed with an algorithm classifier.

Implication/impact: This work is advantageous in achieving efficiency in models. The artificial intelligence model is developed to improve the solution to issues in developing models.

Keywords: artificial intelligence, decision-making, forecasting, models

تطوير نظام الخبراء لعمليات المحاكاة

الملخص: للحصول على نظرة ثاقبة في العديد من تحديات النماذج ، من المهم استخدام الشبكات الاصطناعية في النماذج. تم نشر أوراق بحثية مختلفة حول تقنيات الذكاء الاصطناعي هذه. لا تتناول أي من هذه المنشورات مشاكل حساب التقديرات والتنبؤات لحل بيانات ونماذج العالم الحقيقي من البيانات المقدرة.

الأهداف / الأهداف: أهداف هذا البحث هي : (1) تطوير أسلوب عصبي اصطناعي لحل المشكلات (2) تطوير تقنيات لحل المشكلات المعقدة (3) حساب التقديرات والتنبؤات لبيانات العالم الحقيقي (4) تطوير النماذج من البيانات المقدرة. تعتبر التقنيات التي تمت دراستها في هذا البحث مهمة وضرورية لحل المشكلات المعقدة والغامضة المزيفة في الذكاء الاصطناعي. وبالتالي، يتم استخدام دراسة شاملة تشتمل على التقنيات المطبقة في هذه الدراسة للمقارنات واستخدامها لتحديد طريقة موثوقة للنمذجة والتنبؤ بالمشاكل. يبحث هذا البحث في الإجراءات المختلفة المستخدمة في الذكاء الاصطناعي لنمذجة عملية صنع القرار بكفاءة.

المنهجية / النهج: تم استخدام الدراسات السابقة للأساليب لهذه الدراسة. تتضمن الأساليب المطبقة في هذه الورقة جمع البيانات من REDcap ، وهي أداة لجمع البيانات عبر الإنترنت. تم تحديد ذلك في مجموعة بيانات التدريب (70٪) وتم تقييمه بناءً على بيانات الاختبار (30٪). تم تطوير النموذج باستخدام الشبكة العصبية والتحليل الثنائي ومصنف التعلم الخاضع للإشراف وتحديد النتيجة.

النتائج / النتائج: يتم تقييم النتائج بمقارنة أدائها باستخدام مقاييس الدقة. تم تنفيذ النموذج باستخدام لغة برمجة .MATLAB تمت معالجة البيانات باستخدام مصنف الخوارزمية.

التضمين / الأثر: هذا العمل مفيد في تحقيق الكفاءة في النماذج. تم تطوير نموذج الذكاء الاصطناعي لتحسين حل المشكلات في تطوير النماذج.

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1. Introduction

This research utilizes data from REDcap, an online data collection tool. The model is developed using the neural network, binary analysis, supervised learning classifier, and result determination techniques. Artificial intelligence involves discovering functions that can be performed without being directly programmed to do so. This consists of learning from available data to perform certain tasks. For other advanced functions, this can be challenging to produce the required algorithms. It can be more effective if the machine can develop its algorithm, as opposed to having answers.

Artificial intelligence consists of a wide variety of techniques utilized for the discovery of patterns and relationships in sets of information. The fundamental objective of any artificial intelligence algorithm is to recognize meaningful relationships in generating a generalization of these relationships that interpret new, unseen data. This is one applied aspect. [1] investigates sustainable innovation in businesses using various theoretical theorems. [2] improves the efficiency of models. It also improves the speed with which data are released. It is important to perform comparisons of models applied in machine learning [3]. These models can describe the relationships among the series. As a result, reliable decision-making is made.

The major focus of this study is to develop artificial intelligence models to enhance efficiency in models using artificial neural networks, binary analysis, supervised learning classifier, and the result determination utilizing MATLAB programming. This study has significant contributions. The summary of contributions from the study carried out includes the following:

1) The study gives a theoretical framework for artificial neural network models.

2) This research gives a systematic guide to producing a system consisting of an artificial intelligence system. As a result, the set of collected data is modeled with their normalization obtained during the estimation step is enhanced.

3) The procedure of controlling a system normalization assists in obtaining reliable estimates.

The background study of this research is contained in Section 1. The section is a suitable starting point for the study. Section 2 consists of a review of the literature of this study. This study will complement existing work. Section 3 discusses the theoretical framework of this study. It entails the prediction of data, including the algorithms for the techniques. Subsequently, this is applied to data samples drawn from REDcap, an online data collection tool. This section compares various techniques for estimating models. Section 4 estimates values for the various models. It selects the best technique by comparing their respective statistical estimates. Finally, Section 5 summarizes the research that has been accomplished and the findings of this study. This entails the evaluation of results done by comparing their performance using accuracy metrics. It also describes recommended future research direction of this study.

2. Literature Review

The necessity to utilize artificial intelligence techniques for modeling challenges was established in the previous section. The procedure and techniques used in this study are highlighted and discussed in this section. The theoretical guidelines of the techniques were established while the objectives, scope, and justification for this study were presented. One of the challenges of classifications in applying artificial intelligence is the use of suitable techniques to develop models dependent on available data. The model that would perform optimally among the data features is still open to research.

A variety of artificial learning techniques, despite their respective strengths and weaknesses, have been applied to enhance sustainability in organizations. [4] state their preparedness to apply artificial learning techniques in solving sustainability challenges in organizations that would promote their efficiency. The major objective for the application of artificial intelligence techniques is for encouraging the procurement of sustainable development goals. [5] discuss using data set from

an online platform using kaggle.com. This is reviewed in this paper [6]. According to the paper, data can be divided into several groups namely; network system data, customer and supplier data, data collection, and consumer data. This is used to develop an incisive model of the distribution of class labels for predictor features. The learner is provided with two sets of data, a training set, and a test set. The supervised learning is displayed in Figure. 1.

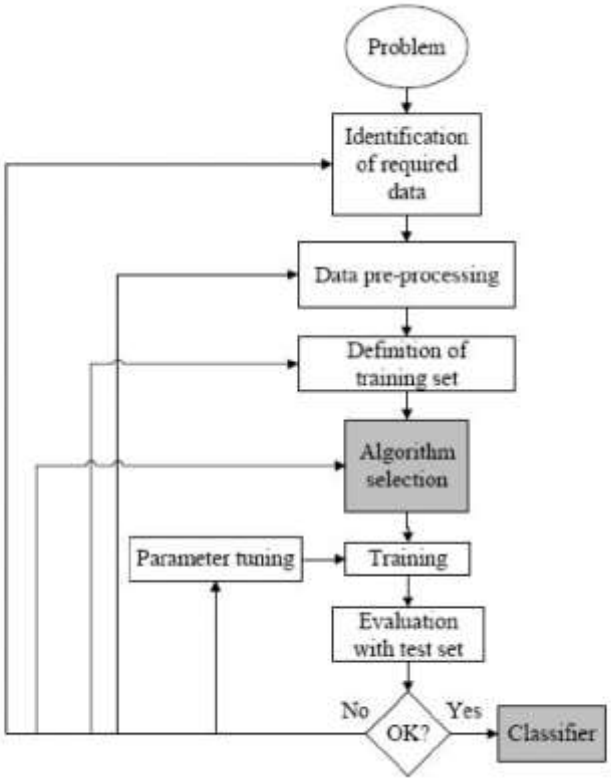

Figure 1. The processes

The research in [7] proposes an efficient framework for a time series analysis. A high-performance method is deployed to the application. The evaluation of the technique indicates that the technique is more accurate than previous techniques. The work in [8] develops efficient data-driven models for accurate forecasts. The aim of [9] is to propose data summarizing the structure of COVID. It utilizes Box Jenkins together with the linear exponential method. The results from the study show the combined technique to be more reliable.

Developing models for the environment is essential [10]. The study introduces an algorithm-based hybrid model. In the paper, the hybrid model performed better in forecasting. [11] proposes a method for developing observed data. In illustrating the evaluation process, some numerical problems were presented. [12] proposed surveying recent ANN applications. These techniques included models applied in machine learning. [13] reported the existence of similarities in models. These models apply to the same objects found in photographs, drawings, and images. [14] proposes the application of new models in residential load forecasting in neural network models. Content evaluation Is inferred using the proposed model compared to load forecasts in buildings.

[15] develops a model for reducing the spread of the COVID disease. A deterministic nonlinear incidence function was used to model the disease. Results from the study indicate the model will be maintained, otherwise, instability will occur. [16] uses chatbots. The study used electronic surveys that were distributed to SMEs operating in London to collect data between April and June 2020. This research applies a layout system to a sustainable business growth model [17]. According to [18], the evaluation and simulation of data were carried out by artificial intelligence, and the system was developed by presenting a method for identifying solutions to digitalization issues in organizations. [19] presents an enhanced set of data for collecting, processing, and controlling for efficiently handling the data produced for manufacturing procedures, which assists in the distribution processes and assessing the market in real-time. An application for an artificial intelligence platform is proposed by [20[. According to the paper, an attempt is made to present the need for quicker activities. The important characteristics for the efficient growth of industries are policies involved in their formulation.

[21] proposes that it is important for variables investigations to be done. These include variables that are important in size data that will affect growth in organizations. [22] investigates an organization's intelligent financial construction

that will affect sustainability in the organizational growth process. This is to provide for organizations requiring research. Moreover, [23] consists of several journals on different sets of challenges facing sustainable development. Furthermore, this paper provides a new understanding of the importance of artificial intelligence applications and models, deterministic nonlinear incidence function was used to model the disease. Results from the study indicate the strength of the model will be maintained, otherwise, instability will occur.

3. Theoretical Framework

The techniques used in this study are presented in this section. This section presents techniques utilized in this study. This section includes data collection, in which data is collected from an online data collection source. The system development is for the application of machine learning techniques undertaken by implementing various machine learning algorithms using MATLAB programming language to input data sets via the artificial neural network, binary analysis, supervised learning classifier, and result determination techniques.

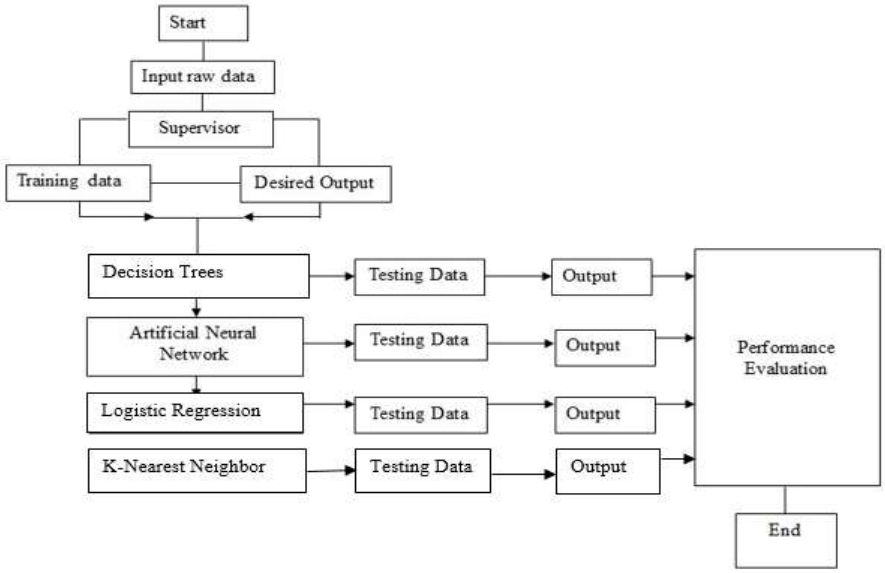

Figure 2. Comparative analysis model.

The ability of these techniques is done using an evaluative mechanism for performance testing. The methodology for the classification is displayed in Figure 2.

Several of the data sets are taken as input for the feature extractor and classification algorithm. The datasets are entered into a sequence of pre-processing blocks. Achieving this objective involves the steps that are depicted in Figure 3. The MATLAB programming language is used to evaluate the models developed in this study. The MATLAB code used for evaluation is given in Appendix 5.

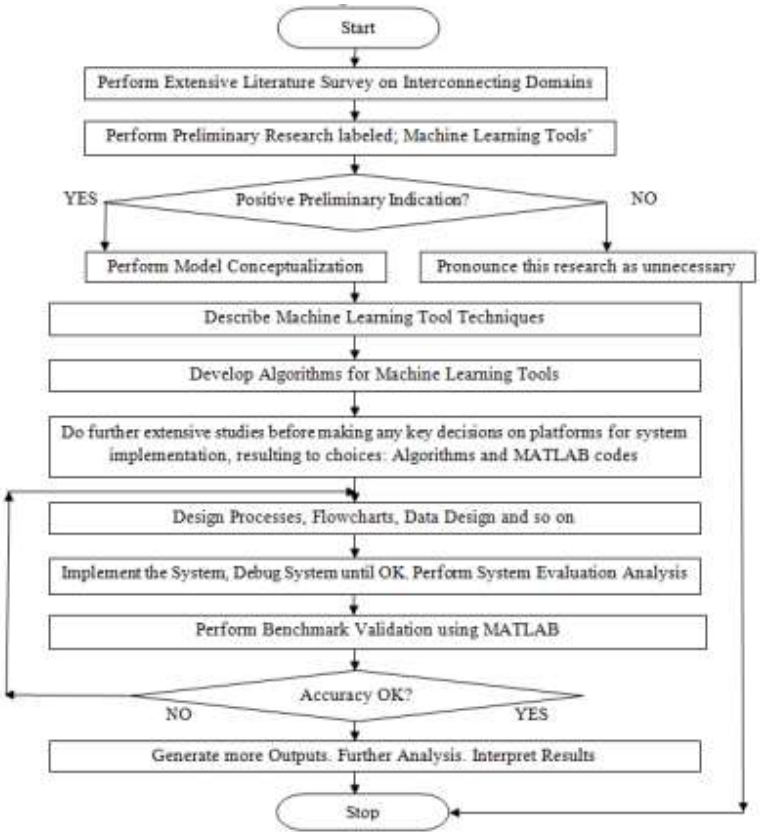

Figure 3. Flowchart of methodology.

The techniques used in this research are presented.

3.1 Data Set

All The set of data is collected from the REDcap online data collection application. REDcap is an online data collection application [24]. A sample of 22 companies was taken with their respective data containing company category, employees, turnover, and balance sheet. It is given in Figure 4.

Company Category	Employees	Turnover	Balance sheet total
Micro	<10	<€2 million	<€2 million
Small	<50	<€10 million	<€10 million
Medium sized	<250	<€50 million	<€43 million

Figure 4. Sample data.

3.2 Artificial Neural Network

ANNs were created for defining the architecture of humans to perform functions that standards can not do. The neural network is classified into a training set, validation set, and evaluation. They provide important techniques for creating systems used in building models [25]. This is shown in Figure 5. Appendix 1 shows the code for Artificial Neural Networks.

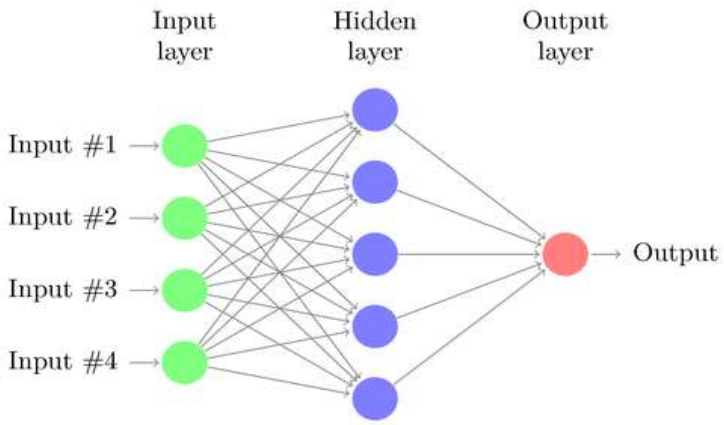

Figure 5. Model of an artificial neural network.

3.3 Binary Analysis

Binary analysis is a statistical system ensuring that its standard form uses a logistic function to model a binary-dependent function, although several complex extensions exist. The binary analysis model is given in Figure 6. The characteristics of the binary analysis are given in Figure 7.

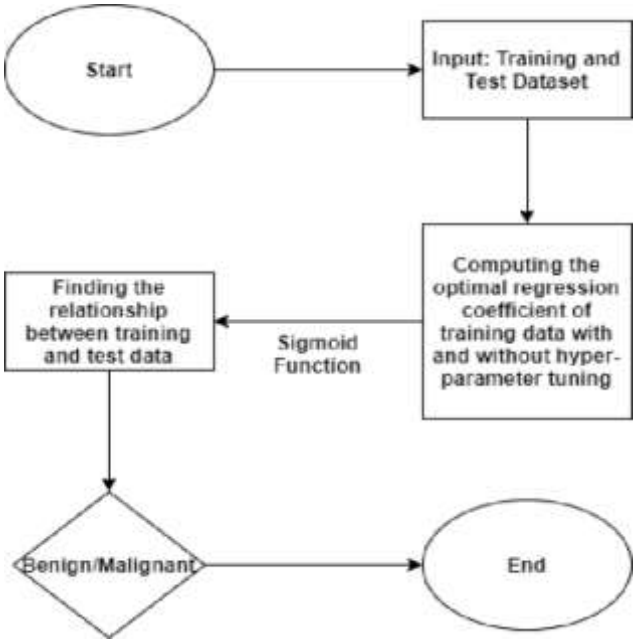

Figure 7. Estimates of binary analysis.

The mathematical notion of binary analysis consists of the variable and the independent variables. The binary analysis model can be written as:

$$(Y) = \text{In}\,(1-\pi) = \beta_0 + \beta_1 X \qquad (1)$$

β_0 and β_1 are defined as intercept and regression coefficients respectively.

The antilog on both results in

$$\pi = P(Y|X = x) = \frac{e^{\beta_0+\beta_1 x}}{1+e^{\beta_0+\beta_1 x}} \quad (2)$$

Binary analysis can entail more than one predictor

$$(Y) = In\ 1-\pi = \beta_0 + \beta_1 + \cdots + \beta_p X_p \qquad (3)$$

Equation (3) is the standard form of a binary analysis model for p predictors.

The regression parameter β is estimated by the maximum likelihood (ML) method. The value of regression coefficients β1…βp corresponds between X and the logit of Y. The odds ratio is estimated using Equation (4)

$$Odd\ (OR) = e^{\beta} \qquad (4)$$

Appendix 2 depicts the MATLAB code used to implement the binary analysis.

3.4 Supervised Learning Classifier

The supervised learning classifier comprises the k-closest training and the output. The results consist of the property value. supervised learning classifier with an algorithm since the data assigned to it is labeled. It is a non-parametric technique as the classification of a test data point depends on the nearest training data points comparatively to considering the variables of the dataset. It is used in resolving classification and regression tasks. Supervised learning utilizes training data to learn the mapping variable that converts input variables (X) into the output variable (Y). It solves for *f* given equation (5).

$$Y = f(X) \qquad (5)$$

It allows the accurate generation of outputs given new inputs.

There are different types. They are classification, regression, and the ensemble.

Classification is predicting results in the description of categorical data.

Regression is used to predict the data that can be described as real values.

An ensemble is a form of supervised learning. It is integrating the predictions of several machine learning models that are separately weak to get an accurate prediction on a new sample. Appendix 3 shows the MATLAB code for the supervised learning classifier.

3.5 Result Determination Technique

A result determination technique consists of a flowchart-like structure, with each node constituted by an attribute and each branch composed of the results of the test, and an individual node consisting of a class label. A result determination consists of chance event outputs and resource costs. The directions from the root to the leaf composes of classification rules. The result determination technique process is given as follows:

1. Decision nodes – composed of squares
2. Chance nodes – comprises of circles
3. End nodes – represented by triangles

The result determination s algorithm comprises two parts: nodes and rules. The standard suggestion of the algorithm is to produce a flowchart diagram that comprises a root node on top. The important factors why the result determination technique is used in data mining and classification. Figure 8 represents a result determination algorithm.

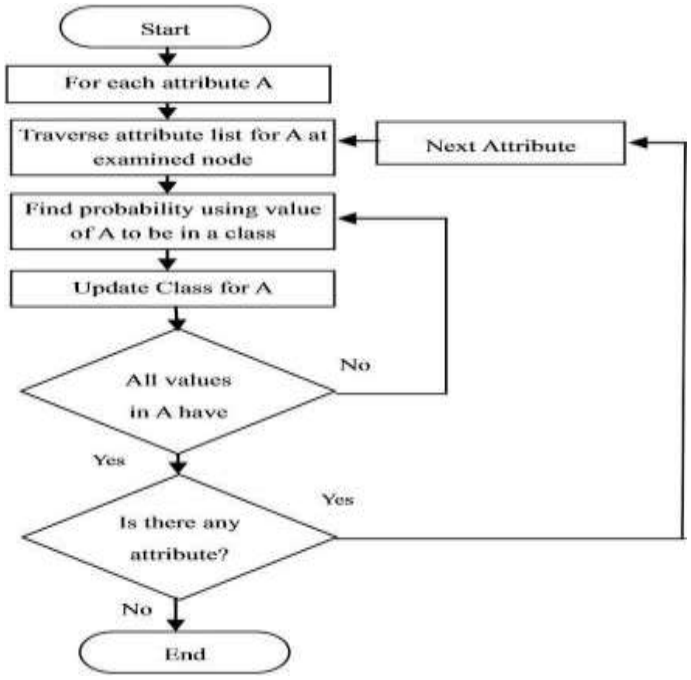

Figure. 8 Result determination algorithm.

Appendix 4 depicts the MATLAB code used to implement the result determination

model. The prediction for this system is implemented using MATLAB and evaluated using the mean squared error.

3.6 Evaluation of Techniques

There are several techniques used for the evaluation of results. The mean squared error (MSE) technique is an accuracy metric used to evaluate the performance of the results in this study. This accuracy metric is the most commonly used in past literature. The comparative analysis of the techniques involves identifying and selecting a reliable and accurate technique by comparing the *mean square error* (MSE) for the respective models, as discussed by [26]. Reliable and accurate techniques must be employed in the modeling of the models, otherwise poor estimates may result. The performances of the neural network, binary analysis, supervised learning classifier, and result determination is assessed by comparing their respective *MSE* values. The technique with the smallest error value is selected as the best-performing technique as discussed by [27].

This approach of assessing the performance of a proposed technique as compared with benchmarks was also used by [28]. The error estimates for the four techniques used to model data in this study are provided to compare the performance of the models and their reliability by comparing actual data with predicted models. *The MSE* values were described by [29] and are outlined as follows:

The errors are computed from a time series, based on an average of weighted past observations. At period *t*, past values of a variable of interest Xt can be observed. The model is applied to the historical observations, and the values Ft+1 are obtained. Once the values are obtained, they can be compared with known values and the error *e* can be calculated. To identify an accurate model, the following steps are followed:

- Choose a method based on previous knowledge about the observed pattern of the time series.
- Use the method to develop fitted values of the data.
- Calculate the error.
- Decide on the appropriateness of the model based on the measure of the error

For the purpose of computing errors, a historical data set called a time series is considered. The time series is represented as follows:

$$F_{t+1} = \frac{X_t + X_{t-1} + \cdots + X_{t-n+1}}{n} \quad (6)$$

$$= \frac{1}{n}\left(\sum_{i=t-n+1}^{t} X_i\right) \quad (7)$$

where t is the most recent observation and $t + 1$ is the next period.

An examination of the error permits the evaluation of whether the chosen model accurately mirrors the pattern exhibited in the sample observations. An evaluation of the reliability of a model requires the specification of criteria.

This study utilizes the *mean square error* (MSE) technique to evaluate the accuracy of the models. The *MSE* is given as

$$MSE = \frac{\sum(e_t)^2}{n} = \frac{\sum(X_t - F_t)^2}{n} \quad (8)$$

This measure defines error as the sum of et divided by the sample size, that is, the number of periods. The *MSE* is a measure of individual errors.

4. Results

This study includes the implementation framework and results of the programming language used from the preprocessing phase to the training and also validation phase of the prediction models. Screenshots of results are presented to support the proposed framework. MATLAB software is used to analyze the techniques used in this study. Appendix 6 shows the MATLAB code used to read the data set file. The data is split into train and test groups. For classification, the preprocessed data is fed to the binary analysis model. The data is split into two parts; the training set (70% of data) and the test set (30% of data). The test set is used to evaluate the performance of the model. Appendix 7 shows the MATLAB programming code used to implement this.

Appendix 7 depicts the MATLAB code used to implement the training of the supervised learning classifier. Appendix 8 depicts the steps for the supervised learning classifier. Appendix 9 depicts the steps for the decision tree model. The test data is used to test the intelligence of the model. The test set is fed to the model

for the model to make predictions. The predicted outcomes from the model will be used to match the actual outcomes of the test set. After the training phase, the classifier is tested and its prediction accuracy is measured. To effectively evaluate the performance of these prediction models, the evaluation criteria used is the mean squared error. The MSE either assesses the quality of a predictor. The MSE of the predictor is computed as

$$\mathbf{MSE} = \frac{1}{n}\sum_{i=1}^{n}(Y_i - \hat{Y}_i)^2.$$

The output for the MSE of selected technique is given in Figure 9. In describing Figure 9, the data for the REDcap online data is analyzed. The data is shown in the graph analysis by MATLAB software, as shown in the figure. The analysis selects the best method for this study. The neural network is selected. Figure 9 shows that the MSE of the neural network reduces over time. The graph also shows the time, performance, and validity check of the analysis. The execution time is very efficient. It is given as 0.0001. As given in the figure, the validity check is good when estimates are compared with actual data.

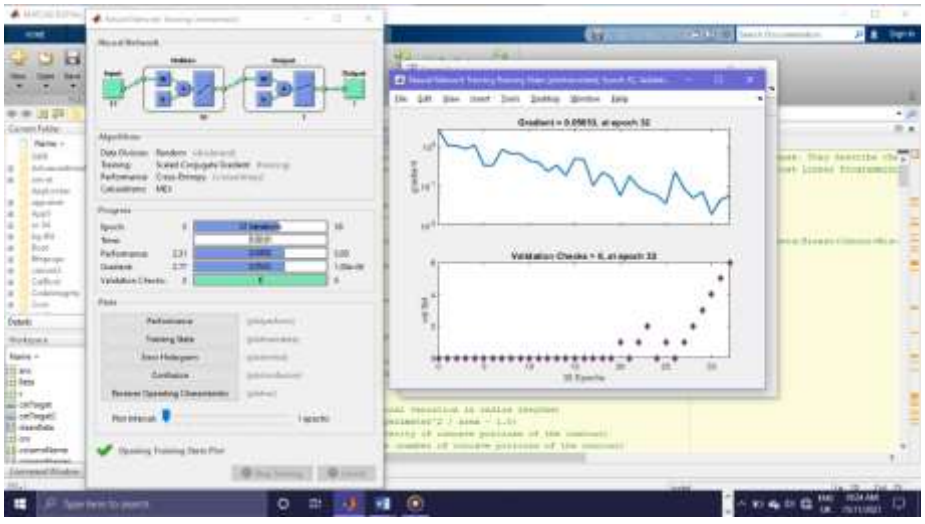

Figure 9 MSE model.

The output for the validity performance is given in Figure 10. The figure shows the validity performance of the neural network. The performance shows a reducing

curve, which indicates efficiency. The graph also shows a reduction in test and trained data. The sharp decrease in the graph signifies a reduction in the MSE and validity values. Overall, there was a reducing trend in data. This shows that data has been following a reducing trend over time.

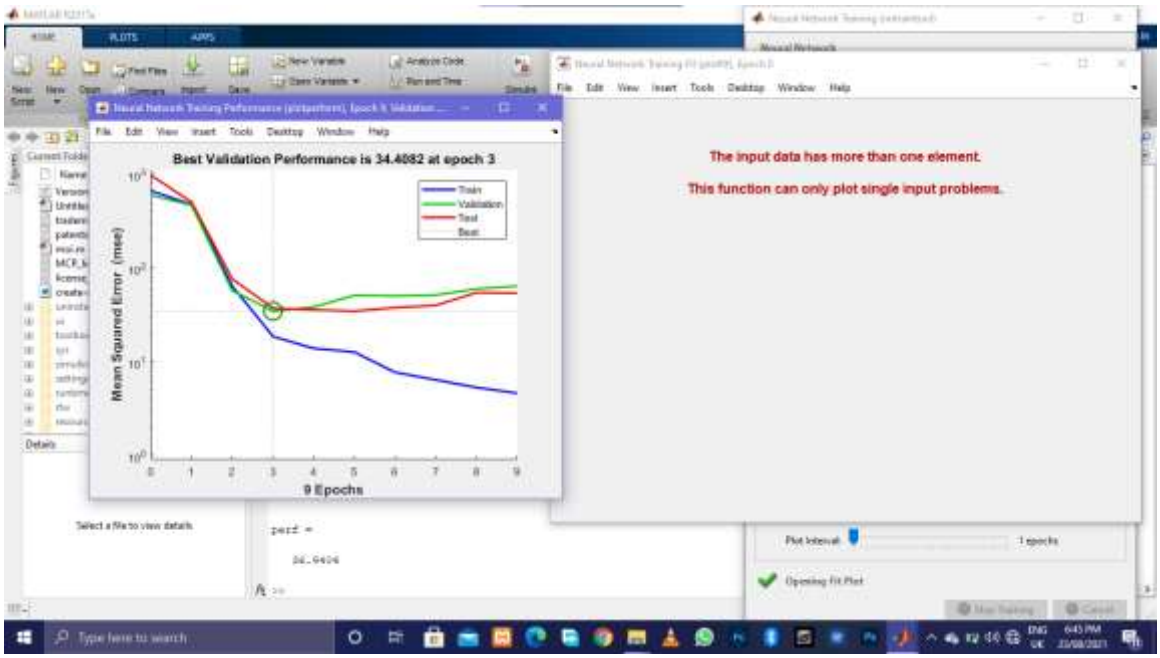

Figure 10. Validity Performance.

When the evaluation techniques are implemented on the REDcap online data collection application, the MSE of the proposed technique, the neural network has the lowest mean squared error of 0.02006, compared with the supervised learning classifier (0.02529), result determination (0.06471) and the binary analysis (0.02941).

This is shown in Table 1. As a result, the neural network has the best prediction accuracy and the lowest mean squared error at 0.02006.

Table 1. Results of MSE for Techniques

Algorithm	MSE
Artificial Neural Network	0.02006
Supervised Learning Classifier	0.02529

Result Determination	0.06471
Binary Analysis	0.02941

Figure 11 and Figure 12 are not required as the study requires the MSE and the validity of the technique.

This study also compares results obtained with previous similar research. This study compares results with [30]. The results for the error values of both studies are given in Table 2.

ANN error value for this study	ANN error value for [30]
0.02006	0.355216

The error value of this study is significantly lower than the previous study. This indicates this study is more efficient than the previous study.

5. Conclusion

A variety of artificial learning techniques, despite their various strengths and Weaknesses were applied in this study. This study compares techniques to identify their reliability. compares various artificial learning techniques to identify a reliable method. The testing of the techniques is focused on 22 testing data datasets. Results show that ANN is the most accurate for estimating data. The proposed method has improved previous methods of modeling data. The techniques are evaluated by investigating the accuracy of the predicted values for artificial neural network (ANN), supervised learning classifier, binary analysis, and result determination techniques by computing and comparing their respective Mean Squared Error (MSE). To identify a robust technique, performance measures are used to test the accuracy of the developed models. This is to investigate the robustness of the techniques. The MATLAB code for evaluation is given in Appendix 5.

The recommended future research for this study involves the following process. Currently, applying artificial intelligence techniques to solving issues with modeling can be important research. These challenges include variables contained in models. Those issues can improve the performance of applying artificial intelligence techniques to the models and getting to know the contributions of each of these variables to the models will need further research.

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Appendix 1

MATLAB Code for Training the ANN model

```
%% TEST NEURAL NETWORK CLASSIFIER %%
dataTestMat=transpose(dataTest{:,:});
targetTestMat=transpose(targetTest{:,:});

testResult = net(dataTestMat);
testIndices = vec2ind(testResult);
subplot(2,2,2);
plotconfusion(targetTestMat,testResult)
[c,cm] = confusion(targetTestMat,testResult);
fprintf('Percentage Correct Classification   : %f%%\n', 100*(1-c));
fprintf('Percentage Incorrect Classification : %f%%\n', 100*c);
subplot(2,2,3);
plotroc(targetTestMat,testResult)
% perf = mse(net, targetTestMat,testResult ,'regularization', 0.01)
err = immse(targetTestMat,testResult);
fprintf('mse of Neural network is: %f\n' ,err)
nnErr=err;
```

Appendix 2
MATLAB Code for binary analysis

```
%% training set %%
mtrain=length(categorical(targetTrain{:,:}));
dataTrainMat2=[ones(mtrain,1) transpose(dataTrainMat)];
ztrain = dataTrainMat2*Beta;%z=beta0*1+beta1*x1+beta2*x2
htrain=1.0./(1.0+exp(-ztrain));
figure
subplot(2,1,1);
histogram(htrain,10)
xlabel('Probabilities')
ylabel('Frequencies')
title('Probability Distribution for Training Data')
```

Appendix 3
MATLAB Code for Training the KNN Model

```
%% KNN %%
knnModel=fitcknn(dataTrain{:,:},categorical(targetTrain{:,:}),'NumNeighbors',10,'Standardize',1);
disp(knnModel);
predictedValues=predict(knnModel,transpose(dataTestMat));
pred = grp2idx(predictedValues)-1
err = immse(targetTestMat,transpose(pred));
fprintf('mse of KNN is: %f\n' ,err)
knnErr=err;
```

Appendix 4
MATLAB Code for Training the DT Model

```
%% DECISION TREES %%
decisionTreesModel=fitctree(dataTrain{:,:},categorical(targetTrain{:,:}));
disp(decisionTreesModel);
view(decisionTreesModel,'Mode','graph')
predictedValues=predict(decisionTreesModel,transpose(dataTestMat));
pred = grp2idx(predictedValues)-1
err = immse(targetTestMat,transpose(pred));
fprintf('mse of decision Trees is: %f\n' ,err)
dtErr=err;
```

Appendix 5
MATLAB Code for Evaluation

```
function V=errperf(T,P,M)
%   rmse (root mean squared error)
%   mape (mean absolute percentage error)
%   e (errors)
%   se (squared errors)
%{
Abbreviations:
e: error(s)
M: METRIC
m: mean
P: PREDICTIONS
p: percentage
s: squared
T: TARGETS
V: VALUE(S)
%}
% Transform input
M=lower(M);
%% Compute metric
switch M
% Errors
case 'e'
  V=T-P;
% Squared errors
case 'se'
  Ve=errperf(T,P,'e');
  V=Ve.^2;
% Mean squared error
case 'mse'
  Vse=errperf(T,P,'se');
  V=mean(Vse);
case 'rmse'
  Vmse=errperf(T,P,'mse');
  V=sqrt(Vmse);
% Relative errors
case 're'
  assert(all(T),'All elements of T must be nonzero.')
  Ve=errperf(T,P,'e');
  V=Ve./T;
% Percentage errors
case 'pe'
  Vre=errperf(T,P,'re');
  V=Vre*100;
% Absolute percentage errors
case 'ape'
  Vpe=errperf(T,P,'pe');
            V=abs(Vpe);
          % Mean absolute percentage error
             case 'mape'
             Vape=errperf(T,P,'ape');
             V=mean(Vape);
```

Appendix 6
MATLAB Code for data set file

```
%% TABLE HEATMAP %%
inputCorr=corr(cleanData{:,:});
imagesc(inputCorr);
newColumns={};
columnNames = cleanData.Properties.VariableNames
for columnName = columnNames
  disp(['the member is ' columnName{1}])
  name= columnName{1};
  if contains(name,'_')
    newColumns(end+1)={strrep(name,'_','-')};
  else
    newColumns(end+1)={name};
  end
end
[X,Y]=meshgrid(1:31,1:31);
set(gca, 'XTick', 1:width(cleanData)); % center x-axis ticks on bins
set(gca, 'YTick', 1:width(cleanData)); % center y-axis ticks on bins
set(gca, 'XTickLabel', newColumns); % set x-axis labels
set(gca, 'YTickLabel', newColumns); % set y-axis labels
set(gca,'FontSize',10) % Creates an axes and sets its FontSize to 18
xtickangle(45)
title('Correlation Heat MAP', 'FontSize', 10); % set title
colormap('jet'); % Choose jet or any other color scheme
txt=sprintfc('%.1f',inputCorr)
text(X(:),Y(:),txt,'horizontalalignment','center','verticalalignment','middle')
colorbar()
```

Appendix 7
MATLAB Code for training of the supervised learning classifier

```
%% TEST-TRAIN DATA SPLIT %%

cv = cvpartition(size(cleanData,1),'HoldOut',0.3);
idx = cv.test;
% Separate to training and test data
dataTrain = cleanData(~idx,:);
dataTest  = cleanData(idx,:);
m = transpose(dataTrain.id);
rowsidx_train = any((targetDataWithId.id==m),2)
targetTrain=targetDataWithId(rowsidx_train,:)
k = transpose(dataTest.id);
rowsidx_test = any((targetDataWithId.id==k),2)
targetTest=targetDataWithId(rowsidx_test,:)
size(targetTest)
size(targetTrain)
catTarget2 = categorical(targetTrain{:,2});
countTarget2 = countcats(catTarget2);
subplot(2,1,2);
h=histogram(catTarget2)
ylabel('Number of Cases')
title('Histogram of Training Data Categories')
%h = histogram('Diagnosis',catTarget,'Counts',2);
y = h.Values;
text(1:2, y+5, string(y));
```

Appendix 8
MATLAB Code for the supervised learning classifier

```
%% TEST NEURAL NETWORK CLASSIFIER %%
dataTestMat=transpose(dataTest{:,:});
targetTestMat=transpose(targetTest{:,:});

testResult = net(dataTestMat);
testIndices = vec2ind(testResult);
subplot(2,2,2);
plotconfusion(targetTestMat,testResult)
[c,cm] = confusion(targetTestMat,testResult);
fprintf('Percentage Correct Classification   : %f%%\n', 100*(1-c));
fprintf('Percentage Incorrect Classification : %f%%\n', 100*c);
subplot(2,2,3);
plotroc(targetTestMat,testResult)
% perf = mse(net, targetTestMat,testResult ,'regularization', 0.01)
err = immse(targetTestMat,testResult);
fprintf('mse of Neural network is: %f\n' ,err)
nnErr=err;
```

Appendix 9
MATLAB Code for decision tree model

```
%% DECISION TREES %%
decisionTreesModel=fitctree(dataTrain{:,:},categorical(targetTrain{:,:}));
disp(decisionTreesModel);
view(decisionTreesModel,'Mode','graph')
predictedValues=predict(decisionTreesModel,transpose(dataTestMat));
pred = grp2idx(predictedValues)-1
err = immse(targetTestMat,transpose(pred));
fprintf('mse of decision Trees is: %f\n' ,err)
dtErr=err;
```

هيئة التحرير

الهيئة الاستشارية

قواعد النشر في المجلة

- أن يكون البحث جديدا، ولم يسبق نشره
- أن يتسم بالأصالة والجدة والابتكار والاضافة للمعرفة
- أن لا يكون مستلا من بحوث سبق نشرها للباحث/للباحثين
- أن تراعى فيه قواعد البحث العلمي الاصيل، ومنهجيته.
- أن يشتمل البحث على:
  - ✓ صفحة عنوان البحث باللغة الانجليزية.
  - ✓ مستخلص البحث باللغة الانجليزية.
  - ✓ صفحة عنوان البحث باللغة الانجليزية.
  - ✓ مستخلص البحث باللغة العربية.
  - ✓ مقدمة.
  - ✓ صلب البحث.
  - ✓ خاتمة تتضمن نتائج وتوصيات.
  - ✓ ثبت المصادر والمراجع.
  - ✓ الملاحق الملازمة(إن وجدت.)
- في حال (نشر البحث ورقا)يمنح الباحث نفسه نسخة من عدد المجلة الذي نشر بحثه بها و10 نسخ من بحثة بشكل مستقل
- في حال اعتماد نشر البحث تؤول حقوق نشره كافة للمجلة، ولها ان تعيد نشره ورقيا أو إلكترونيا، ويحق لها
- إدراجه في قواعد البيانات المحلية والعالمية- بمقابل أو بدون مقابل -وذلك دون حاجة للإذن الباحث.
- لا يحق للباحث إعادة نشر بحثه المقبول للنشر في المجلة- في أي وعاء من أوعية النشر -إلا بعد إذن
- كتابي من رئيس هيئة تحرير المجلة
- نمك التوثيق المعتمد في المجلة هو نمط IEEE

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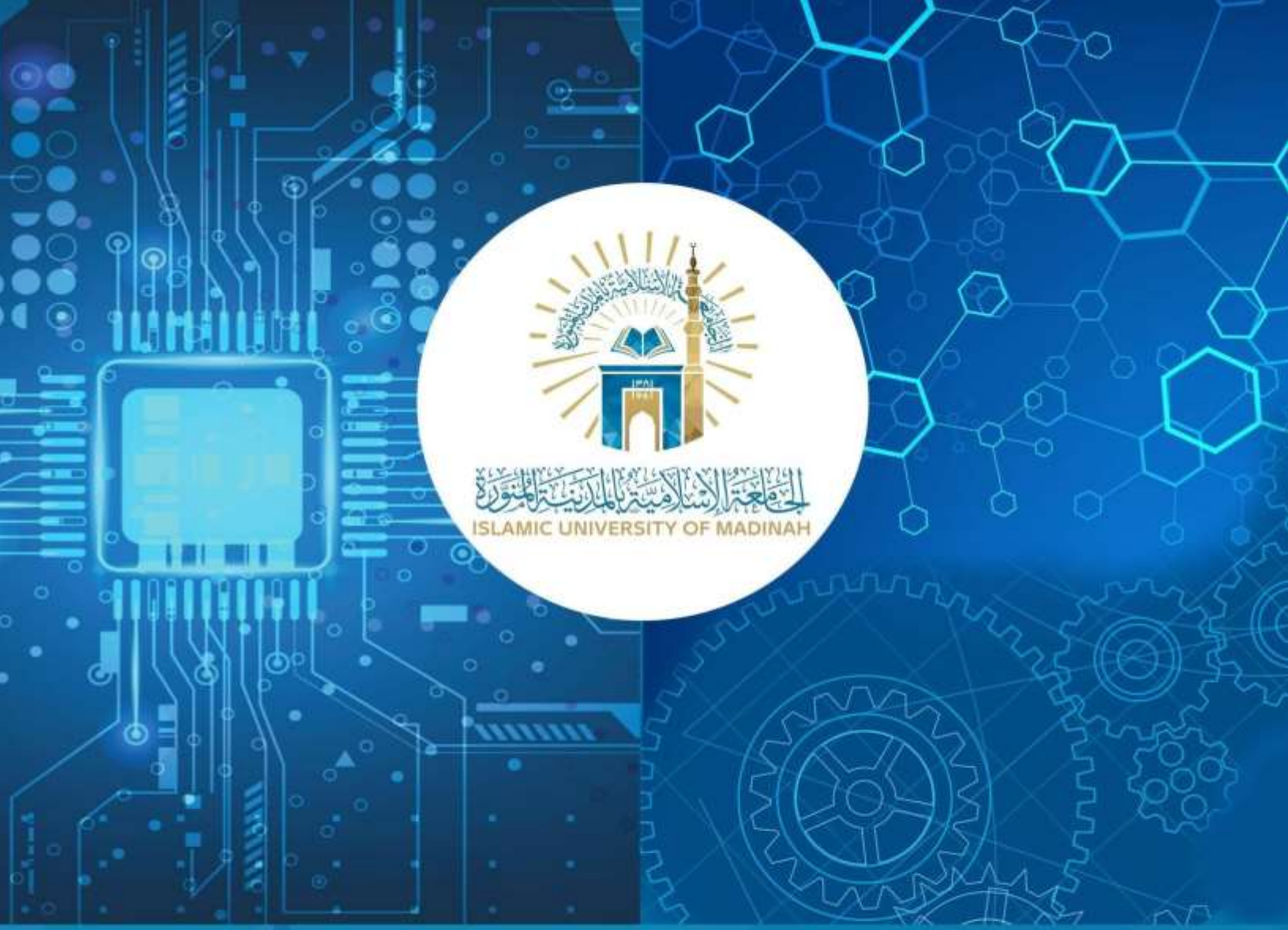
الآراء الواردة في البحوث المنشورة تعرب عن وجهة نظر الباحث فقط، ولا تُعرب بالضرورة عن المجلة.


بسم الله الرحمن الرحيم



مجلة الجامعة الإسلامية

للعلوم التطبيقية

مجلة علمية دورية محكمة

العدد: II السنة: الرابعة ١٤٤٤ هـ