

CIVIL LIABILITY ARISING FROM THE USE OF NANOTECHNOLOGY IN THE MEDICAL FIELD. A COMPARATIVE STUDY BETWEEN JORDANIAN, EMIRATI AND EGYPTIAN LEGISLATION

Mutasem Heif, University of Petra
Shadi Abu Helo, University of Petra

ABSTRACT

Nano technology or technology is based on the construction of new materials, devices and systems, by controlling the physical, chemical and biological properties of the substance while exploiting the new properties arising out of this substance. Given the importance of this technology, many researches have begun in the field of Nano medicine, its applications and its uses in the medical field.

It should be noted that Jordanian, United Arab Emirates and Egyptian legislation did not explicitly address the use of nanotechnology in the medical field, but did address explicit legal texts that protect the human body from any abuse, including those in the field of medical error.

Since there was no legal connection to the use of nanotechnology in the medical field; General rules establishing civil liability for the use of nanotechnology in diagnosis and treatment are applied on the basis of fault, damage and causation.

Keywords: Nano Treatment, Nanotechnology, Medical, Civil Liability for Nanotechnology

INTRODUCTION

The medical profession is as old as human. Long periods granted it traditions, customs and characteristics. It is a humane, scientific and ethical profession that requires those who practice it to respect the human being as a person, soul and body in all circumstances and conditions, which necessitates the practitioner of the medical profession to set a good example in his work and behavior in a way that preserves people's bodies and souls, doing his best to serve them¹.

Since the medical profession emerged as a humanitarian and scientific profession, man has realized its variable benefits. Which led to the endeavor to develop it and take care of it and pay attention to its secrets, Accordingly, the medical profession developed due to its strong connection with technological and scientific development².

Medical works and related technology are considered very important; This is because it is directly related to members of society³. Medical research and scientific and biological experiments in the medical field have raised the need to strike a balance between contemporary scientific requirements in the medical field and the need to impose respect for the human body, and to preserve legitimate and legal human rights and human dignity, which should not be violated nor compromised.⁴

Nanotechnology in the medical treatment field has appeared as a result of scientific development in the medical field, and nanotechnology is one of the most important modern technologies that changed the common patterns⁵, as Nano science will unify and include all types of science with limitless possibilities, and its results cannot be guessed to the extent that some scientists have called this era (the nano era), and considered nanotechnology to be the revolution of the twenty-first century⁶.

Nanotechnology allows the production of products that are considered imaginary compared to what is available today, and allows many forms and images to be used on a large scale, to include all fields of medicine, engineering, computer science, space science and many other fields⁷. The importance of nanotechnology is in the ability to significantly change the properties of materials when it breaks into smaller and smaller pieces, especially when reaching the smallest sizes such as Nano, when the secondary grains begin to show unexpected and unpredictable properties that were not known before, meaning that the properties of the secondary grains become different from the properties of the parent material and are not present in it⁸.

Knowing that science and technology are at the center of the wheel of progress at the present time, and although nanotechnology represents one of the most prominent features of the scientific revolution, there is an urgent need to know the side effects of using nanotechnology in the medical field in particular, but; since there are rare known risks of using nanotechnology, this calls for a lot of caution and anticipation, and calls for shedding light on the legal aspect of using this technology by clarifying and determining the civil liability of doctors for the wrong or improper use of nanotechnology in the medical field (Al-Hiyari, 2008).

And to clarify the civil liability resulting from the use of nanotechnology in the medical field, we will divide this research paper into two sections as follows (Manar, 2019):

The First Topic

What is nanotechnology and its legal framework

The Second Topic

The limits of legalization of nano-medical works and the scope of civil liability resulting from their use (Manar, 2019).

The First Topic: What is nanotechnology and its legal framework

Nanotechnology covers a wide range in the medical and engineering field and expands to include multidisciplinary fields for the benefit of medicine, physics, chemistry, engineering, and many scientific aspects at the applied level, and the idea of nano is summarized in controlling anything in a size smaller than a micrometer⁹.

There is a lot of speculation about nanotechnology and what this technology may produce in terms of advanced research prospects, and thus nanotechnology is considered one of the most important emerging issues (Mohammad, 2016).

To talk in detail about the nature of nanotechnology and its legal framework, we will divide this topic into two requirements (Abdullah, 2012):

The First Requirement: What is nanotechnology?

The Second Requirement: the legal framework for nanotechnology in the medical field.

The First Requirement

What is nanotechnology?

We often hear the term nanotechnology and its applications that have caused an amazing scientific revolution. What is this science, and what is meant by the term nanotechnology, and accordingly, to explain what nanotechnology is, we will divide this requirement into two sections; In the first section, we discuss the definition of

nanotechnology and its uses, and in the second section, we discuss the concept of nano-medicine and its uses (Mohammad, (n.d.)).

First Section

Definition of Nanotechnology and its Uses

The term nano is defined linguistically as “a part of a billion. A nanometer is one part of billion of a meter.” In order to clarify the small size of the nano, we mention this example; The thickness of one human hair is 50 micrometers, or 50,000 nanometers, and the smallest things that a person can see and see with his eyes is estimated to be 10,000 nanometers wide, which shows the smallness and accuracy of the nano size ¹⁰.(Mohammad, 2012)

The word “nano” refers to everything that is small in size, minute in body, and the word “nano” is linguistically derived from the Greek word “nanos”, which means a small person or a dwarf, and there is no unit of measurement smaller than the nanometer, which is the smallest unit known so far ¹¹.

On the scientific side, there were many definitions that define the concept of nanotechnology; some defined it as "a technology that aims to obtain infinitesimal bodies in different shapes that may be molecules, fibers or channels because of their special importance due to their multiple applications" ¹².(Al Ali, 2019).

Others defined it as “that technology that is based on building new materials, devices and systems, by controlling the physical, chemical and biological properties of the material while exploiting the new properties arising from this material,” and others defined it as “a set of processes of separation, formation and integration of materials at the level of atoms.” or particles.” ¹³Others defined nanotechnology as “the study of materials in the atomic or partial scale so that their properties differ significantly from the properties of the same materials in their larger shape and size" (Mohammad, (n.d.)).

Others defined it as “a multidisciplinary science that covers several scientific fields such as chemistry, physics, medicine, biology, engineering, electronics and new technologies with the aim of reducing the sizes of materials”¹⁴.

Nanotechnology is used in many general uses; Nanotechnology applications have penetrated most fields of life, and they have had a significant positive impact, such as, for example: Increasing the efficiency of electronic devices and at the same time minimizing their size and reducing the energy consumed to operate these devices, as is obvious in smart phones, computers, and chipsets for saving and storing information. Nanotechnology also helped in water treatment and air filtration, and contributed to the development and improvement of the food world, from growing grains to packaging, In addition to working to increase the quality of food, improve its usefulness and maintain its safety, and helped store energy by improving the quality and efficiency of batteries, and had a clear imprint in the manufacture of lightweight and highly efficient spacecraft, as it facilitated the work of transporting the drug directly to the disease-affected organs and cells ¹⁵.

Thus, nanotechnology gives a set of materials and mechanisms that enable the examination of the basic nature of matter in the nanometric scale, which allows processing and dealing with material on the atomic and molecular scale, and since the nano unit is the smallest metric unit of measurement ; accordingly nanotechnology deals with units and measurements less than atom ¹⁶. (Daraz, 2019).

Second Section

Nano Medicine and its Uses

There is still no clear and accurate scientific definition of the term "Nano medicine", but most of the studies in this field dealt with nanotechnology in general, and highlighted in particular the areas and limits of the application of nanotechnology in the medical field to show what is known today as the term Nano medicine ¹⁷. (Al-Bashir, 2020)

The medical applications of nanotechnology are the most important for this technology among all the available and expected applications and uses of this modern technology, due to its direct connection to human health and life, as nanotechnology is one of the medical applications related to accurate diagnosis and treatment with high efficiency in addition to many uses in the field of health care, and confronting the most deadly diseases in humans. Accordingly, many researches in the field of Nano medicine and its applications and experimental uses began in many research centers around the world, for example; Using nanotechnology to find valuable solutions to the Corona pandemic, which is scientifically known as (COVID-19), So that nanoparticles can be used successfully to eliminate groups of coronaviruses inside the human body by taking advantage of their abilities to confine, freeze and prevent these viruses from attacking host cells, researchers have been able to develop a nanoparticle that keeps the air away from coronaviruses, and these nanomaterials are characterized by being degradable and non-toxic, as a research team in Germany succeeded in preparing a nanomaterial that fights the virus by covering the virus (COVID-19); This covering prevents the virus from affecting host cells, and one of the advantages of this material is that it attacks the virus only when it infects lung cells, and researchers are developing Nano sensors to develop ways to accurately test infection with the Corona virus ¹⁸.

Nanotechnology can also be used in the pharmaceutical industries, because the nanoparticles are very small, and therefore the drug can be delivered with great accuracy to the affected cells and not only to the diseased tissues, and it also helps in reducing the side effects of the drug because it deals directly with the diseased cells only, thus reducing the side effects that may occur from the arrival of the drug to other parts of the body whose treatment was not intended ¹⁹, and through the micro- and ultra-high nanotechnology, it has become possible to diagnose cancer cells in its early stages, with an accuracy that reaches the point of detecting a single cancer cell ²⁰.

Nanotechnology can be used in the field of stem cells, so that a nano-body loaded with stem cells is inserted into the patient's organ in order to inject it with stem cells ²¹, in addition to using nanotechnology in medical cosmetics; as nanoparticles are used in the field of sun protection products in order to raise the effectiveness of these preparations ²².

From the foregoing, we notice the diversity of medical applications and uses of nanotechnology, however, there are many current problems that face Nano medicine, the most important of which are the problems related to the legal aspect of this technology, especially with regard to issues related to Nano toxicology and the negative side effects on the human body and health resulting from the use of this technology ²³. which will be the title of our research in the next requirement.

The Second Requirement

The Legal Framework for the Use of Nanotechnology in the Medical Field

The development of nanotechnology and its progress with its new manifestations may seem at first glance strange to the existing legal system, because the law, with its various provisions and details, guarantees in the first place the protection of the physical and moral sides of the human being and protects his life against any attack that affects him, however, the nature of medicine and nanotechnology may raise controversy, especially when the abstract legal rules clash with the humanitarian considerations on which the rules for using nanotechnology in the medical field are based ²⁴, Accordingly; a question arises about the

extent to which Jordanian, Emirati, Egyptian and international legislation cares about nanotechnology on the one hand and the life and health of the human body on the other hand, and the extent to which general legal rules can be applied to them, and accordingly we will divide this requirement into two sections; In the first section, we will talk about nanotechnology in Jordanian, Emirati and Egyptian legislation, and in the second section we will deal with nanotechnology in international law.

First Section

The use of nanotechnology in the medical field in the Jordanian, Emirati and Egyptian legislation

By extrapolating the legal texts in Jordanian, Emirati and Egyptian legislation, we find that there is no special law or special legal texts dealing with the use of nanotechnology in the medical field or dealing with the civil liability resulting from its use until present, and therefore the legal basis for civil liability for the use of nanotechnology in the medical field in Each of Jordan, the UAE and Egypt is based on a medical error that requires liability for medical work²⁵. Whereas, there is no legal basis for the use of nanotechnology in the medical field; It is also the case that we must resort to the general rules that evaluate civil liability for medical work on the basis of medical error, so that the civil liability of a doctor who uses nanotechnology in diagnosis and treatment is based on error, as is not acceptable to leave the wrongdoer without accountability, And the use of nanotechnology in the medical field required the doctor to bear the consequences of his error whenever he committed a mistake²⁶,

The error is the basis of the civil liability of the doctor, as there must be an error issued by the practitioner of medical work, and it must be proven, otherwise the liability for the practice of medical work is negated. This is in accordance with the traditional theory followed by the French legislation, which affirmed that for civil liability to be established, there must be an element of error²⁷, and the Jordanian, Emirati and Egyptian legislation followed the same approach²⁸.

Although there is no legal basis for the use of nanotechnology in the medical field, nevertheless, it must be noted here that the UAE legislator has mentioned in the Executive Regulations of Federal Decree-Law No. 4 of 2016 regarding medical liability in Article 3 Paragraph 4 that stated, "The rules and procedures in this article shall be applied to cases of treatment of a special nature, which include: C- Any other treatment determined by the Minister in coordination with the concerned health authorities."

By extrapolating the aforementioned article; We find that the phrase "any other treatment determined by the minister" is absolute, and since the absolute is unchanged, medical treatment using nanotechnology can be included under this text if nanotechnology is approved as a treatment method by the competent minister, as Article 5 of the UAE Medical Liability Law states that "the doctor is prohibited from: 4- Using unlicensed or illegal methods in dealing with the patient's health condition"²⁹, and the Jordanian legislator had the same law of the UAE legislator in preventing the doctor from using any unlicensed method for the purposes of diagnosis and treatment. As Article 8 of the Jordanian Medical and Health Liability Law states that "the service provider is prohibited from: Using unlicensed diagnostic or therapeutic means or medicines to treat the service recipient"³⁰.

As for the Egyptian legislator, it is still in the process of preparing the medical liability project, which is still before the Egyptian parliament, and accordingly there is no text similar in Egyptian legislation to what was stated in Article 3 of the UAE Medical Liability Law.

From the foregoing, we find that the Jordanian, Emirati and Egyptian legislations did not explicitly address the use of nanotechnology in the medical field, but they dealt with explicit legal texts that provide protection for the human body from any aggression, including the abuses that occur in the field of medical error.

Second Section

The Use of Nanotechnology in the Medical Field in International Law

With regard to international law and international treaties and conventions, it did not specifically and explicitly address the use of nanotechnology in the medical field, but rather dealt with the protection of the human body from the dangers resulting from scientific development in the medical field, and it dealt with medical experiments on humans due to the close connection between these experiences and the protection of human rights. Especially, the sanctity of the human body from tampering, and the human right in his physical being and the safety of his body. Accordingly, several important international conferences were held regarding the protection of human rights, especially those related to protecting the human body from the dangers of scientific and technological progress in the field of medical sciences.

Among these conferences was the International Conference on Human Rights (Tehran 1968)³¹, and this conference dealt with various aspects of human rights, the most important of which was the eleventh resolution adopted by the conference unanimously, which aims to protect human rights and life, especially after the exposure of the human body to the dangers resulting from scientific development in the medical field, one of its most prominent results was; Talking about scientific discoveries and steps of technological progress, the conference pointed out that although this progress has opened wide horizons for economic, social and cultural progress, it can endanger the rights and freedoms of individuals and their bodies, and therefore it will be necessary to be the subject of continuous attention,

The conference also affirmed its belief in the principles of the Universal Declaration of Human Rights and other international instruments in this field, and urged all peoples and governments to fully pledge allegiance to the principles embodied in the Universal Declaration of Human Rights, especially what is stated in Article 3 of it³², and to redouble their efforts in order to provide life that is consistent with freedom and dignity and conducive to providing protection for the body and mind of all human beings³³.

The Fourteenth International Conference on Penal Law³⁴ also addressed the problems that it is provoked by medical experiments on humans on both the curative and non-curative levels, and one of the most important recommendations of this conference was to prevent medical experiments on humans, specifically experiments that do not respect the established rules for conducting experiments on humans, and to legislate deterrent penalties for that with the aim of protection of the physical, mental and psychological safety of the person who is subject to this experiments³⁵.

Many international declarations have also done the same, including the Helsinki Declaration³⁶, which recommended the exchange of experiences and knowledge in the field of policy-making for science, technology and innovation.

It also affirmed the need to strengthen the existing partnership between legislators, scientists, and the private and public sectors in order to develop national innovation systems, and to consider whether there is a need to coordinate practical principles that regulate scientific and technological research applications, and to search for ways to coordinate these principles, and to establish the necessary systems for that.³⁷

Accordingly, we find that international treaties, agreements and declarations did not explicitly mention the use of nanotechnology in the medical field, but rather dealt with the issue of protecting the human body in general, and protecting the human body from risks resulting from scientific development in the medical field in particular, and addressed the issue of medical experiments and their legalization.

The second topic: the limits of legalization of Nano medical works and the scope of civil liability resulting from their use.

The practice of Nano medical work that includes diagnosis, treatment and surgery requires compromising the safety of the human body, and the Jordanian, Emirati and Egyptian legislator has criminalized any unlawful infringement on the safety of the human body. However, as an exception, it permitted medical works in general, including Nano medical works, if they met certain specific conditions. Thus; if these conditions are negated or one of them is negated, the cause of the permissibility falls and the liability is established.

Accordingly, in order to clarify the limits of the legalization of Nano medical works and the scope of civil liability resulting from their use, we will divide this topic into two requirements.

The First Requirement: the limits of legalization of Nano medical works

The Second Requirement: the scope of civil liability resulting from the use of nanotechnology.

The First Requirement: the limits of legalization of Nano medical works

There are boundaries between the legalization of Nano medical work and the crimes that affect the safety of the human body which entails liability; This is because the practice of Nano medical work requires compromising the safety of the human body with the intention of treatment, and accordingly, the practice of Nano medical work here is subject to right and wrong that endangers the life and safety of the patient's body, especially that modern medical research has confirmed the extreme complexity of the risks and damages resulting from the use of nanotechnology in the medical field, however, the legal texts and general protective rules in the field of civil liability for medical actions, including the use of nanotechnology, affirms decisively that Nano medical work is outside the scope of the criminalization of assault on the safety of the human body and enters the circle of permissibility if the legally established conditions and controls are met³⁸.

Accordingly, in order to clarify the conditions for the permissibility of Nano medical works, we will divide this requirement into three sections; The first section: the legal authorization, the second section: the patient's consent, and the third section: the intention of treatment.

First Section: Legal Authorization

To allow the use of nanotechnology in medical and surgical work, the person who performs it must be legally licensed to practice the profession of medicine and surgery. Otherwise, he will be questioned, both criminally and civilly, for the harm he causes to the patient, and the patient's consent does not affect that even if his recovery and treatment is achieved³⁹.

We believe that it is not adequate that a medical practitioner obtains a license to practice the profession of medicine and surgery, but legal authorization goes beyond that to include a license to use nanotechnology in treating the patient, because it is not permissible to use this technology to treat a specific disease unless it is approved as a method of treatment, and unless this technique is licensed to treat this disease.

The two researchers hope that the Jordanian, Emirati and Egyptian legislators will not be satisfied with the requirement that the doctor be licensed to practice surgery and medical work in the use of nanomedicine. But to be scientifically and technically qualified to practice this modern technology in the medical field.

Section Two: Patient Consent

The legalization of the use of nanotechnology in medical and surgical work requires patient consent, and patient consent is one of the conditions for legalization. The aim of requiring patient consent is to preserve his right to physical safety and health and respect for his personal freedom. The patient's consent is one of the most important conditions for justifying and legalizing Nano medical works. This is because the doctor is considered a representative of the patient who implements his desire for treatment, and in the absence of this consent, the doctor is not entitled to begin his work on the patient's body, and if he does so, he will be mistaken and must bear the consequences of the risks arising from the treatment, even if he did not commit any mistake, and even if the motive is for the benefit of the patient; Because the latter is a free human being who has sacred rights over his body, which may not be violated without his consent⁴⁰, and consent means the patient's waiver of the legally established immunity for his body, thus negating the nature of violation from the nanomedical work and thus becoming a permissible act⁴¹.

The doctor cannot exceed this condition unless the patient is in a condition that does not enable him to express his consent, such as if he is unconscious or there is a case of necessity such as an imminent danger that threatens the patient's life and health and calls for the doctor's intervention⁴².

The Third Section: The Intention of Treatment

Permissibility of the use of nanotechnology in medical and surgical work must be with the intent of treating the patient, improving his health condition and relieving his pain. The intention to treat is one of the essential conditions for the legalization of Nano medical works and the denial of the criminal aspect of them. Accordingly, if the condition for intent to treat is lapsed, the Nano medical work leaves the circle of permissibility and the civil liability of its practitioner is established⁴³.

The Jordanian legislator dealt with the intention of treatment in Article 5 of the Jordanian Medical and Health Liability Law⁴⁴, as did the Emirati legislator in Article 3 of the Medical Liability Law⁴⁵, and the Egyptian legislator in Article 20 of the Egyptian Medical Ethics Law⁴⁶.

The Second Requirement: the scope of civil liability resulting from using nanotechnology in the medical field Whoever breaches a legal obligation and violates a legal rule that affects the public interest of society, his criminal legal liability is thus established and realized, and this results in a penalty. But if the breach of a legal obligation affects the private interests of one or more members of the society and does not affect the community's interest, then the civil liability of the responsible person is established, and the penalty here is the compensation that obligates the person who violates the legal obligation, and the penal liability and civil liability may combine together; As a result of violating the interest of society and a private interest at the same time, in this case the penalty is a penal punishment and a civil compensation, and in this case the criminal liability affects the civil liability in many respects⁴⁷.

To clarify the scope of civil liability resulting from nanotechnology in the medical field in detail, we will divide this requirement into two sections; In the first section, we will talk about the nature of civil liability resulting from the use of nanotechnology in the medical field, and in the second section we will discuss the elements of civil liability resulting from the use of nanotechnology in the medical field.

Section One: The nature of civil liability resulting from the use of nanotechnology in the medical field

Nanotechnology as a modern and advanced technology is progressing at faster than the legal rules governing medical liability, and despite the development of laws and

regulations that govern the conditions for practicing the medical profession, most Arab legislation has followed the impact of the French civil legislation that evaluates civil liability on medical errors in accordance with the general rules, civil liability For the doctor is based on the general rules of civil law, specifically Article 1382 and what follows ⁴⁸.

Civil liability for the use of nanotechnology in the medical field in addition to the general rules, is based on the idea of error and harm and the causal relationship between them, as Article 256 of the Jordanian Civil Code states that “every harm to others obliges the perpetrator, even if he is minor, to compensate for the harm,” and Article 282 of the UAE Civil Transactions Law stipulates that “every harm to others obliges the perpetrator, even if he is a minor, to compensate for the harm,” and Article 163 of the Egyptian Civil Code states that “every error that causes harm to others obliges the one who committed it to compensate for the harm resulted”

Referring to the general rules, we can define civil liability as “the obligation of a person to compensate the harm he has caused to another person, and the penalty is to compensate for the harm that resulted from his breach of an obligation imposed on him” ⁴⁹.

And the use of nanotechnology in the medical field is based as a basic rule on the obligation to provide the necessary care. The practitioner of medical work must provide the necessary medical and health care according to the data of science, medical experiments and various experiences ⁵⁰, and accordingly we find that the practitioner of medical work is not obligated to achieve recovery for the patient, but rather to do the best effort, so that he is discharged as soon as he exerts the required care, even if the result of recovery is not achieved ⁵¹; The medical profession depends on possibilities in nature, as many factors are not controlled by the doctor, so the diagnosis made by the doctor, for example, is the result of the knowledge and experiences available to him, and it is the result of mental and logical extraction in light of the information provided to him and the results of examinations ⁵².

The basic justifications for the rule that the medical practitioner and the physician are obligated to provide the necessary care and not to achieve the result ⁵³; is the presence of several considerations and factors out of the doctor’s control, such as the patient’s body responding to treatment, genetic factors, external circumstances in which the doctor practiced his medical work, the capabilities available to the doctor such as devices and their development, and other considerations and external factors that the medical practitioner and the doctor do not have control over ⁵⁴.

The Jordanian legislator confirmed that the medical work is subject in terms of the responsibility to provide the necessary care on the part of the medical practitioner, as Article 5 of the Medical and Health Liability Law No. 25 of 2018 states that “the service provider must perform his work in accordance with the requirements of the ethics, accuracy and honesty of the profession, and in accordance with the recognized scientific principles, and in a manner that achieves the necessary care for the patient.”

The Emirati legislator also emphasized that medical work is subject, in terms of determining liability, to providing the necessary care on the part of the medical practitioner, as Article 3 of Federal Decree Law No. 4 of 2016 on medical liability states that “everyone who practices the profession in the country must perform his duties with the accuracy and honesty required by the profession and in accordance with the recognized scientific and technical principles, and in a manner that achieves the necessary care for the patient.” Article 6 of the same law states that “a medical error is what a practitioner commits as a result of any of the following reasons: 3- Failure to provide the necessary care.”

Section Two: Elements of civil liability resulting from the use of nanotechnology in the medical field.

The general rule in civil liability stipulates that a person is responsible for his personal behavior, and this rule has been codified in most civil laws ⁵⁵, and accordingly, a medical practitioner who uses nanotechnology is subject to the provisions of medical liability when

something he does that requires accountability; Because medical liability is a form of civil liability in general ⁵⁶.

Based on the foregoing, in order for civil liability to be established for the use of nanotechnology in the medical field - whether it is contractual or tortuous - it must be based on three pillars: an error made by the medical practitioner, harm to the patient who was treated using nanotechnology, and the causal relationship between error and harm is as follows:

First, The Medical Error

Error is the basis of medical liability, and it depends on whether it is established or not. There must be an error made by a doctor, and this error must be proven, otherwise there is no liability on the medical practitioner who uses nanotechnology ⁵⁷.

Despite the reluctance of most legislations to define medical error, leaving this to jurisprudence and the judiciary, the Jordanian legislator has defined the medical error well in Article 2 of the Medical and Health Liability Law No. 25 of 2018 by saying “Medical error: is any act, omission or negligence committed by the service provider , that does not comply with the prevailing professional rules within the available work environment and results in harm.”

Likewise, the UAE legislator that defined the concept of medical error in Article 6 of Federal Law No. 4 of 2016 regarding medical liability, which states that “a medical error is what a practitioner commits as a result of any of the following reasons:

- 1) Unawareness of the technical matters that he is supposed to be familiar with for everyone who practices the profession of the same degree and specialization.
- 2) Not following the recognized professional and medical principles.
- 3) Not providing the necessary care.
- 4) Neglect and failure to follow caution, and the executive regulations of this decree is specified by the Criteria For Serious Medical Error Act

By extrapolating the aforementioned two articles, we find that the most prominent forms of medical error are ; leaving the medical rules and principles of the doctor who uses nanotechnology, in addition to violating the duties of caution and vigilance imposed on him, and through the foregoing, medical error can be defined as negligence or deviation from the doctor in his behavior on the medical rules and principles that science or what is recognized theoretically, practically and scientifically dictates at the time of executing the medical work without his will but with the possibility of expectation their occurrence.

As for the Egyptian legislator, it did not define medical error and did not put texts on physicians' mistakes occurring when they practice their profession, leaving the matter to the general rules, specifically the law of practicing the profession of medicine, the Doctors Syndicate Law and the Medical Ethics Regulations, which showed that medical error is represented in several forms; like negligence that applies to all cases in which the perpetrator neglects to take the necessary precautions to protect the rights of others that if taken would not affect these rights, and frivolity, which means lack of knowledge or skill in technical and professional matters of medicine, lack of precaution, which means the lack of caution and attention, that causes the doctor to be responsible for the result of his behavior, because he could have prevented the error from happening if he had acted with caution and prudence, This form of medical errors also means that the erring doctor knows the dangerous nature of his behavior without taking the necessary precautions to prevent the occurrence of the error, and the failure to observe the laws and regulations . The form of medical error represented by non-observance of laws and regulations is sufficient in itself to establish the physician's civil liability, even if it does not result in a specific harm, and includes the form of non-implementation of all organizational rules, including instructions ⁵⁸.

Second: The Harm

The establishment of civil liability, both contractual and tortuous, requires the availability of the element of error and its association with the element of harm and the causal relationship between them. If any of these pillars is absent, the civil liability lawsuit that requires interest is not accepted, and the burden of proving the harm falls on the injured person, and he has the right to prove the harm incurred by all means of evidence being a physical fact⁵⁹.

Harm can be defined in general as “the harm that affects a person because of a violation of one of his rights or a legitimate interest, whether that right or that interest is related to the safety of his body, money, affection, freedom, honor, or consideration”⁶⁰.

So, it is not enough to determine the doctor's responsibility that an error has been established on his part only, but it is also required that the injured patient prove the harm he sustained as a result of the doctor's error. The provisions of harm in medical liability do not depart from the rules of harm according to the general rules of civil liability, so that the doctor is not bound within the scope of his contractual liability except for direct and expected harm, except in the cases of fraud and serious error, he is asked then about the expected and unexpected error, but in the case of his tortuous liability; He is obligated to compensate the expected and unexpected harm in all cases⁶¹.

Therefore, the patient's harm due to the use of nanotechnology in his treatment or diagnosis is the first spark from which medical liability is triggered, because the harm is the spirit of civil liability in general.

The intended harm here is not the failure of the patient to be recovered as a result of the use of nanotechnology in his treatment. Rather, it is the error resulting from the doctor's mistake or negligence in carrying out the duty of caution and vigilance imposed on him during the practice of medical work; because the general rule is that the doctor's obligation is an obligation to provide care and not to achieve a result.

There are many forms of harm resulting from medical error. The harm may be physical or moral, and the physical damage may affect a material interest; Such as what affects a person in his body, life, or money, and bodily harm is achieved in the event of an assault on the body, which results in disfigurement, disability, or injury, such as the death of the patient, wounding, or harm to his body such as infection with another disease, or to cutting, eradication, amputation or disabling one of his limbs.

Or the failure of one of the senses to function, or a distortion in the patient's body⁶², and the financial harm is derived from the physical harm, which is the financial loss such as the expenses of treatment or restoration incurred by the patient as a result of the doctor's error, and the financial harm includes the lost profit caused by the harm to the injured person⁶³.

As for moral harm, it is a harm that affects an interest or an unphysical right; like it hurts Man in his emotions, feelings, freedom, honor, reputation, or social status. The Jordanian legislator dealt with moral harm in Article 267 of the Jordanian Civil Code⁶⁴, as did the UAE legislator in Article 293 of the Civil Transactions Law⁶⁵, and the Egyptian legislator in Article 222 of the Civil Code⁶⁶.

The researchers believe that the practical reality confirms the difficulty of identifying and proving the harm resulting from the use of nanotechnology in the medical field due to the novelty, accuracy and complexity of this technology.

Third: The causal relationship between the medical error and the harm resulting from it.

It is not enough to determine the responsibility of the doctor and medical practitioner only to have the two elements of error and harm, but also the presence of a causal relationship linking the error of the medical practitioner when he uses nanotechnology to the harm that affected the injured patient.

The causal relationship is a material relationship that begins with the action of the doer and is linked in moral terms to what should be expected from the familiar results of his action ⁶⁷, and thus the causal relationship consists of two elements; The material element that initiates the action of the cause that leads to the harmful result, and the moral element; Which lies in the existence of a mental relationship between the offender and the illegal result that occurred by his mistake for violating the requirements of caution imposed on him ⁶⁸.

The causal relationship in the scope of the use of nanotechnology in medical work is difficult to prove. This is due to the multiplicity of causes of harm to the human body, which is characterized by physiological and anatomical features, so that it is possible that the source of this harm that afflicted the human body was external factors that intervened and contributed to causing this harm ⁶⁹, however, it is agreed that the causal relationship is not interrupted by the interference of other factors in bringing about the result as long as these factors are familiar and expected according to the normal course of things, and vice versa if the factors are unfamiliar and external, then the causal relationship between action and the result is absent, which is known as the appropriate causal theory ⁷⁰.

The causal relationship in the field of medical liability is subject to the general rules in civil liability. The injured patient must prove that the harm occurred to him caused and resulted because of the fault of the treating physician. To say that there is a causal relation between the error and the harm inflicted on the patient, this link must be certain and direct, The causal relationship is broken if there is an external cause and unfamiliar factors; such as the patient's mistake, the action of others and force majeure, and an example of the patient's mistake is by taking materials that the doctor clearly warned against after he explained the consequences of taking them, and an example of the mistake of others is the mistake made by another doctor, and an example of force majeure is the death of the patient from fear and shock due to the sound of thunder or an earthquake ⁷¹.

The concerned judge has to ascertain the existence of a causal relationship that links the error of the medical practitioner to the harm that befalls the injured patient ⁷². The verification of the existence of the causal relationship is an objective matter that is to be assessed by the concerned judge, and when he decides whether of approval or denial, there is no control for the Court of Cassation, as long as the judgment of the case judge was fundamentally causative and based on legal evidence in the case, and this is confirmed by the decision of the Egyptian Court of Cassation, which stated: "It is decided that the causal relationship is an objective issue that the concerned judge solely has to assess, and when he decides on it, whether it is approval or denial, then there is no control for the Court of Cassation, as long as he depended in his judgment on the grounds that lead to it." ⁷³.

RESULTS

- 1) Nanotechnology as a modern and advanced technology is moving faster than the legal rules governing medical liability.
- 2) The civil liability for the use of nanotechnology in the medical field, beside the general rules, is based on the idea of error and harm and the causal relationship between them.
- 3) The Jordanian, Emirati and Egyptian civil legislations have followed the approach of the French civil legislation, which establishes civil liability on medical errors in accordance with the general rules, and the civil liability of the physician is based on the general rules of the French Civil Code in accordance with the provisions of Article 1382.

- 4) The practical reality confirms the difficulty of identifying and proving error and harm and the causal relationship between them resulting from the use of nanotechnology in the medical field due to the novelty, accuracy and complexity of this technology.

RECOMMENDATIONS

- 1) The researchers hope that the Jordanian, Emirati and Egyptian legislators legislate a special law or special legal texts related to the use of nanotechnology in the medical field.
- 2) The researchers wish the Jordanian, Emirati and Egyptian legislators to expand the text on forms of medical errors to include form of medical errors resulting from the use of nanotechnology.
- 3) The researchers wish the Jordanian, Emirati and Egyptian legislators to add a condition for the use of nanotechnology in the medical field, that the doctor should be a technical specialist in modern nanoscience and technologies when using this technology in treatment; To ensure his efficiency and experience in using this technology in order to preserve human life and souls, and not to permit the use of this technology for every doctor just because he has obtained a license to practice medicine and surgery.
- 4) The researchers hope that the Jordanian, Emirati and Egyptian legislators establish legal units in their respective judicial structures that are specialized in the field of medical errors, specifically with regard to the use of nanotechnology in the medical field.

REFERENCES

- Al-Hiyari, A. (2008). The civil liability of the doctor in the light of the Jordanian and Algerian Legal System, House of Culture for Publishing and Distribution, (*1st Edition*). Amman – Jordan, 7.
- Al-Zahra Manar, F. (2019). The civil liability of the Anesthesiologist, A comparative study, House of Culture for Publishing and Distribution, (*2nd Edition*), Amman - Jordan, 15.
- Al-Zahra Manar, F. (2019). The civil liability of the Anesthesiologist, A Comparative Study, House of Culture for Publishing and Distribution, (*2nd Edition*), Amman - Jordan, Page 15.
- Al-Zahra Manar, F. (2019). The civil liability of the Anesthesiologist, A Comparative Study, House of Culture for Publishing and Distribution, (*2nd Edition*), Amman - Jordan, 15.
- Abdullah, A. (2012). Nanotechnology, Al Dar Al Arabiya Book Library, (*1st Edition*), Cairo - Arab Republic of Egypt, 11.
- Al-Bashir Mohammad, M. (2012). The dangers of Nanotechnology, Dar Al-Hamid, (*1st Edition*), Amman - Jordan, 17.
- Al-Bashir Mohammad, M. (n.d.). The dangers of nanotechnology, previous reference, 19.
- Al Ali, Y. (n.d.). Criminal responsibility for the use of nanotechnology in the Medical Field, previous reference, 140-141.
- Al-Bashir Mohammad, M. (n.d.). The dangers of nanotechnology, previous reference, 26.
- Al Ali, Y. (2019). Criminal liability for the use of nanotechnology in the medical field, Dar Al-Nahda Al-Arabiya, (*1st Edition*), Cairo - Arab Republic of Egypt, 30.
- Al Ali, Y. (n.d.). Criminal responsibility for the use of nanotechnology in the medical field, previous reference, 31-32.
- Al-Bashir Mohammad, M. (n.d.). The dangers of nanotechnology, previous reference, Pages 39-40.
- Abdullah, A. (n.d.). Nanotechnology between Hope and Deviation, Arab House Book Library, (*1st Edition*), Cairo - Arab Republic of Egypt, 18.
- Abdullah, A. (n.d.). Nanotechnology between Hope and Deviation, previous reference, 19.
- Al-Hiyar, A. (n.d.). The civil liability of the doctor in the light of the Jordanian and Algerian Legal System, previous reference, 102.

- Article 5 of the Jordanian Medical and Health Liability Law No. 25 of 2018 states that: "The service provider must perform his work in accordance with the ethics, accuracy and safety of the profession and in accordance with the recognized scientific principles, and in a manner that achieves the necessary care for the patient and not to exploit his need for the purpose of achieving illegal advantage. for himself or for others, without discrimination between patients, and abiding by the legislation in force.
- Article 4 of Federal Law No. 4 of 2016 concerning UAE Medical Liability states: "Everyone who practices the profession in the country must perform his work duties with the accuracy and integrity required by the profession and in a manner that achieves the necessary care for the patient."
- Article 20 of the Egyptian Medical Ethics Law No. 283 of 2003 states: "The doctor shall do everything he can to treat his patients, work to relieve their pain, improve their treatment, and provide equal care for them without discrimination."
- Article 1382 of the French Civil Code states that : "every act whatsoever committed by a person that causes harm to others requires the person who committed the harm through his error to compensate for this harm."
- Al-Hiyari, A. (n.d.). The civil liability of the doctor in the light of the Jordanian and Algerian Legal System, previous reference, 14.
- Article 1382 of the French Civil Code, stipulates that "every act of any person that causes harm to others requires the one who committed the harmful act by his own fault to compensate for this harm," and Article 256 of the Jordanian Civil Law, states that "every harm to others obliges the doer to (even if he is a minor) to guarantee the harm," and Article 282 of the UAE Civil Transactions Law, states that "every harm to others obliges the doer, to (even if he is a minor) to guarantee the harm". And Article 163 of the Egyptian Civil Code states that "every error that causes harm to others, obligates the person who committed it o pay for compensation."
- Al-Qaisi, A. (2001). Problems of medical liability resulting from artificial insemination, (*1st Edition*), House of Culture for Publishing and Distribution, Amman - Jordan, 68.
- Al-Bashir, M. (2020). Possible Applications of nanotechnology in the treatment of Covid-19. Research published in the Journal of the Arab Scientific Society Organization.
- Al Ali, Y. (n.d.). Criminal liability for the use of nanotechnology in the medical field, previous reference, 38.
- Article 3 of the Universal Declaration of Human Rights states that "everyone has the right to life, liberty and security for himself".
- Al Ali, Y. (n.d.). Criminal Liability for the Use of Nanotechnology in the Medical Field, Previous reference, 47.
- Al-Fadl, M. (2012). Medical liability: A comparative study, (*1st Edition*), House of Culture for Publishing and Distribution, Amman - Jordan, 57.
- Article 267 of the Jordanian Civil Law No. 43 of 1976 states: "1- The right to security also deals with moral harm. Every infringement on others in their freedom, honor, reputation, social position, or financial consideration makes the infringer liable for the guarantee"
- Article 193 of Law 5 of 1985 regarding the issuance of the UAE Civil Transactions Law states that: "1- The right to security deals with moral harm, and it is considered moral harm to infringe on others' freedom, honor, reputation, social status, or in a financial consideration"
- Article 222 of the Egyptian Civil Code No. 131 of 1948 states that: "1- The right to security deals with moral harm, and it is considered moral harm to infringe on others' freedom, honor, reputation, social status, or financial consideration. ".
- Daraz, N. (2019). Nano science and technology, research published in the Journal of the Arab Scientific Society Organization.
- Decision of the Egyptian Court of Cassation - Criminal Departments - No. 22440 of 1959, Judicial session 15/2/1990, the website of the Egyptian Court of Cassation, available at the following link: <https://www.cc.gov.eg/>.
- Dudin, M. (n.d.). The doctor's individual civil liability for his professional work, Previous Reference, 129.
- Dudin, M. (2006). *The doctor's individual civil liability for his professional works, master's thesis in law*, Birzeit University, Palestine, 24.
- Dudin, M. (n.d.). The doctor's individual civil liability for his professional work, previous work, 120.
- For more on the topic of the International Conference on Human Rights (Tehran 1868) see the Human Rights Office of the Tehran Declaration, University of Minnesota, viewed on 9/6/2020, available at the following link: <http://hrlibrary.umn.edu/arab/b006.html>.
- Fatima Al-Zahra Manar: The Civil Liability of the Anesthesiologist, A Comparative Study, and previous reference. Page 108
- Ibeh, K. (n.d.). The Doctor's Criminal Liability and its Evidence, A Comparative Study, House of Culture for Publishing and Distribution, (*2nd edition*), Amman - Jordan, 50.
- Jordanian Medical and Health Liability Law No. 25. (2018).
- Khalil, A. (2009). Medical applications of nanotechnology, King Fahd University of Petroleum and Minerals Publications, 35.
- Lafi, M. (n.d.). Criminal liability for medical error, a comparative study, previous reference, 21.

- Lafi, M. (n.d.). Criminal liability arising from medical error, a comparative study, previous reference, 77.
- Lafi, M. (n.d.). Criminal liability for medical error, a comparative study, previous reference, 128-129.
- Lafi, M. (n.d.). Criminal liability for medical error, a comparative study, previous reference, Pages 127-128.
- Manar, F. (n.d.). The Civil Liability of the Anesthesiologist, A Comparative Study, previous reference, 209.
- Manar, F. (n.d.). The civil liability of the anesthesiologist, A comparative study, previous reference. Page 182.
- Medical work is based as a basic rule on the obligation to provide the necessary care, but the exception to this rule is the medical practitioner's obligation to achieve a result, and the physician's or medical practitioner's obligation to achieve the result of all medical work is considered an exception, and is limited to some medical works whose nature is compatible with achieving the result, and within certain limits, for more review Dr. Eman Al-Jabri: Legal Liability for Medical Errors, First Edition 2011, New University House, Alexandria - Egypt, Page 206.
- Morqos, S. (1971). Civil liability in the legalizations of Arab countries, (2nd Edition), Institute of Arab Research and Studies, Cairo - Egypt, 127.
- Mohammad, M. (n.d.). Criminal and international liability for the use of medical Nanotechnology, Previous reference. 205.
- Mohammad, M. (n.d.). Criminal and international liability for the use of medical nanotechnology, previous reference, 8.
- Mohammad, M. (2016). Criminal and international liability for the use of medical nanotechnology, Arab Studies Center for Publishing and Distribution, (1st Edition), Giza - Arab Republic of Egypt, 7-8.
- Mohammad, M. (n.d.). Criminal and international liability for the use of medical Nano-Applications, previous reference, 225.
- Mohammad, M. (n.d.). Criminal and international liability for the use of medical nano-applications, previous reference, 222.
- Mohammad, M. (n.d.). Criminal and international liability for the use of medical Nano-applications, Previous reference, 60.
- Mohammad, M. (n.d.). Criminal and international liability for the use of medical nano-applications, previous reference, 219-220.
- Mohammad, M. (n.d.). Criminal and international responsibility for the use of medical nano-applications, Previous reference, 68.
- Mohammad, M. (n.d.). Criminal and international liability for the use of medical nano-applications, previous reference, 165.
- Mohammad, M. (n.d.). Criminal and international liability for the use of medical nano-applications, previous reference, 165.
- Mohammad, M. (n.d.). Criminal and international liability for the use of medical nano-applications, previous reference, 153.
- Mohammad, M. (n.d.). Criminal and international liability for the use of medical nano-applications, previous reference, 151.
- Mohammad, M. (n.d.). Criminal and international liability for the use of medical nano-applications, previous reference, 226.
- Nammour, M. (2019). Explanation of the penal code, special on crimes against persons, (8th Edition), House of Culture for Publishing and Distribution, Amman - Jordan, 163-164.
- Obaid, M. (n.d.). The criminal liability of medical doctors, previous reference, 110.
- Obaid, M. (n.d.). The criminal liability of medical doctors, previous reference, 110.
- Obeid, M. (n.d.). The criminal liability of doctors, house of culture for publishing and distribution, (1st Edition), Amman - Jordan, 40.
- Obaid, M. (n.d.). The Criminal Responsibility of Doctors, previous reference, 28.
- Pursuant to Article 1147 of the French Civil Code.
- Sultan, A. (n.d.). Sources of commitment in the Jordanian Civil Law (a comparative study of Islamic Jurisprudence), first edition 1987, House of Culture for Publishing and Distribution, Amman - Jordan, 371.
- The International Conference on Human Rights was held in Tehran between April 22nd to May 13, 1968, to review the progress achieved during the twenty years since the adoption of the Universal Declaration of Human Rights, and to formulate a program for the future. Considering problems related to the activities undertaken by the United Nations to promote and encourage respect for human rights and fundamental freedoms; For more view the Human Rights Office, Tehran Declaration, University of Minnesota, reviewed on 3/6/2020, available at the following link: <http://hrlibrary.umn.edu/arab/b006.html>.
- This conference was held in Vienna in the first week of October 1989, and among the works included in this conference was the study of (Penal Law to Face Modern Medical Methods) referred to by Dr. Mohammad Eid Al-Gharib, Medical and Scientific Experiments and the Sanctity of the Bodily Entity of Man - a Comparative Study, Cairo, Sons of Wahba Hassan Press, First Edition 1998, p. 32.

This declaration was organized by the Finnish Parliament, UNESCO and the Islamic Educational, Scientific and Cultural Organization (ISESCO) on January 13 and 14, 2003, in Helsinki, an international round-table meeting entitled (Policies on Science, Technology and Innovation) and delegates from 31 countries participated in this important meeting.; For more see the UNESCO website, Helsinki Declaration, viewed on 10/10/2020, available at the following link: <http://www.unesco.org/new/ar/natural-sciences/science-technology/science-legislation/helsinki-declaration/>

This is approved by the decision of the Egyptian Court of Cassation, which stated: “The relationship of causality in criminal matters is a material relationship that begins with the act committed by the offender and is linked from a moral aspect with what he should expect from the usual results of his action if he did it deliberately. And this relationship is an objective issue that the concerned judge is the only one to estimate, and when he decides whether approval or denial, there is no control over the Court of Cassation.” Decision of the Egyptian Court of Cassation – Criminal Departments – No. 3983 of 1986, Judicial session 19/11/2018, the website of the Egyptian Court of Cassation is available at the following link: <https://www.cc.gov.eg/>

UAE Medical Liability Law No. 4. (2016).

Williams, L. (2007). Nanotechnology, Dar Al-Farouk for cultural investments, (1st Edition), Giza - Arab Republic of Egypt, 14.

Received: 28-Jan-2022, Manuscript No. JLERI-21-9985; Editor assigned: 31-Jan-2022, PreQC No. JLERI-21-9985 (PQ); Reviewed: 14-Feb-2022, QC No. JLERI-21-9985; Revised: 28-Feb-2022, Manuscript No. JLERI-21-9985 (R); Published: 08-Mar-2022.
--