“Mandatory insurance against civil liability of medical robots operating with AI technologies in the United Arab Emirates”

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MANDATORY INSURANCE AGAINST CIVIL LIABILITY OF MEDICAL ROBOTS OPERATING WITH AI TECHNOLOGIES IN THE UNITED ARAB EMIRATES

Abstract

The integration of AI-enabled medical robots into the medical field has increased the potential risks to which patients may be exposed. To protect patients' rights, this study aims to explore and analyze the need for mandatory insurance against civil liability of medical robots operating with AI technologies in the United Arab Emirates. Such insurance is intended to ensure adequate compensation, reinforce legal protection, and uphold confidence in medical practice, while also contributing to societal stability and supporting the growth of the insurance sector. The study employed a combination of descriptive and analytical methods. It concludes that smart medical robots are neither inanimate objects nor irrational beings. It recommends legislative regulations granting them digital legal personality under specific controls, recognizing their independent financial status, and enabling them to bear civil liability for actions causing harm. The study showed an upward trend in the number of insurance companies providing liability coverage for damages caused by AI-operated medical robots, increasing from two in 2020 to ten in 2025, and expected to rise further if full legal personality is granted. The research findings suggest amending the UAE Civil Transactions Code and the Medical Liability Law to codify civil liability provisions for autonomous smart medical robots and to mandate liability insurance. Furthermore, as insurers' obligations depend on establishing the insured's liability, UAE law should grant the injured party a direct right of action against the insurer.

Keywords insurance, civil liability, medical robot, AI, United Arab Emirates

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INTRODUCTION

The world has recently witnessed remarkable developments in AI applications, which have been used in many fields aimed at serving humanity. AI has entered many sectors, including commerce, media, education, and the judiciary (Fouad, 2020). Robots, software, and smart applications have emerged to help solve problems, perform calculations, and predict future events (Sordin, 2020).

The United Arab Emirates is considered one of the first countries to employ AI technologies in the service of humanity. The government has created two new ministerial positions: Minister of State for AI and Minister of State for Advanced Sciences (National Committee on Sustainable Development Goals, 2017). The government also developed strategies for the National Program for AI in 2020, and the Dubai Digital Authority developed a set of principles and guidelines for AI systems in 2018 (UAE National Program for AI, 2020; Karim, 2022).

Smart robots operating with AI technologies have been used in several fields, such as engineering, airports, communications, traffic regulation, self-driving cars, etc. (Abdullah, 2021; Al-Ma'dawy, 2021). Smart robots have also entered the field of concluding and documenting marriage contracts (Gulf News, 2018). In medicine, they helped in diagnosing diseases, taking X-rays, analyzing samples, prescribing medications, performing surgeries, and caring for patients (Ahmad, 2022; De Micco et al., 2025).

With the increasing use of smart robots in the medical field, difficulties and challenges may arise, particularly those related to civil liability for medical errors caused by these robots. This is particularly true because these robots operate autonomously and are equipped with advanced technological capabilities that enable them to perform precise tasks according to the patient's health condition. This could lead to the risk of escaping or exceeding limits, harming the patient, and resulting in legal liability, especially in terms of compensation (Fouad, 2020). Hence, an urgent need for civil liability insurance for medical robots equipped with AI technologies has emerged. This need is not limited to the United Arab Emirates; rather, it constitutes a matter of global legal concern. Accordingly, reference has been made to European Union legislation, scholarly literature on comparative law, and the legislative policies of various countries cited in the study, including the United States of America, Saudi Arabia, and South Korea.

The problem addressed in this study lies in identifying the party responsible for compensating for damages caused by smart medical robots and determining the possibility of insuring against the civil liability arising from their errors. Addressing this research problem will clarify three key issues: the basis of civil liability for damages caused by smart medical robots, the feasibility of granting them legal personality, and the need for a mandatory insurance system to manage potential liabilities.

1. LITERATURE REVIEW

According to Zhang and Lu (2021) and Al-Mahdi (2025), robots are one of the most important forms of artificial intelligence (AI), a field of computer science that focuses on creating machines capable of performing intelligent tasks that mimic human intelligence, such as learning, thinking, problem-solving, and decision-making. Al-Rashidi (2024) argues that the term 'robot' comes from the word '*robota*', which means hard or difficult work. In Arabic, however, a robot is defined as 'a mechanical human being or a device driven by an internal mechanism that mimics the movements of a human or a living being' (Omar, 2018; Abdulghani, 2023).

Scientifically, it is defined as an intelligent electromechanical device that operates using complex computer programs enabling it to perform arduous or precise tasks independently through artificial reasoning in a safe, skilful, and effortless manner (Al-Khatib, 2018; Mustafa, 2025). The American Institute defines a manipulator as a reprogrammable, multifunctional manual manipulator designed to move materials, parts, tools, or special devices through various programmed movements (Boucharb & Klou, 2022). The International Federation of Robotics (*IFR*) defines a robot as an actuator programmable in two or more axes with a degree of autonomy that moves within its environment to perform intended tasks (Dagher, 2023).

The EU Artificial Intelligence Act 2024 does not provide a definition for a robot, but it defines an AI system as 'a machine-based system that is designed to operate with varying levels of autonomy and that may exhibit adaptiveness after deployment, and that, for explicit or implicit objectives, infers, from the input it receives, how to generate outputs such as predictions, content, recommendations, or decisions that can influence physical or virtual environments' (Article 3(1)).

Referring to the European Union's Civil Law Rules on Robotics issued in February 2017, we find that they did not provide a definition for a smart robot but spoke of two types of robots: personal needs robots and medical robots, devices that operate using AI technologies to perform tasks in the field of medicine, such as diagnosis, prescription of medications, surgery, healthcare, and others (Dagher, 2023; Shaima, 2024).

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There are many examples of these robots, including the following: the *Puma 560* robot, used to perform scans of the human brain; the *Heartthrob* robot, used to perform endoscopic surgeries; the *Da Vinci* robot from Intuitive Surgical, used to perform surgeries without any human intervention; the *Star* robot, used to perform complex surgeries, especially on knee joints; and the *Rosa* robot, used for spinal surgeries (Liow et al., 2017; Al-Rashidi, 2024).

In the United Arab Emirates, medical robots have been used in several areas, such as examining samples, displaying results, and disinfecting patient rooms. They have also been used in pharmaceutical work, as the Universal Hospital in Abu Dhabi established the first pharmacy operating with robots in the Middle East in 2017 to reduce waiting time for receiving medication and reduce the possibility of human error (Badawi, 2020; Ahmad, 2022).

The integration of AI-powered medical robots into healthcare has created an urgent need to clearly determine which parties should be held liable for any medical errors these robots may cause. While several studies have examined the issue of medical civil liability for both human physicians and medical robots, none have specifically addressed the question of civil liability insurance for these robots. Al-Qurashi (2023) discussed insurance contracts in general and explained their importance. He discussed civil liability insurance for human physicians, outlining its parties, the rights and obligations of each, the beneficiaries of the insurance, and the risks included in the scope of insurance and those excluded from it. However, he did not discuss the civil liability of medical robots, the basis of this liability, or the benefits and feasibility of insurance. His study also focuses primarily on Saudi law, with reference to other laws.

Al-Rashidi (2024) examined the ruling on the use of surgical robots under Islamic law (*Shari'a*). He discussed the types of liabilities and medical liabilities in light of Islamic jurisprudence. He reviewed the pillars of this liability by focusing on the fault elements. However, he did not discuss the matter from a legal perspective, nor did he discuss medical robots or address insurance issues. Furthermore, his study is based on *Shari'a* and not on legal principles. Mustafa (2025) discussed the civil liability resulting from the damage caused by medical robots. He discussed the pillars of this liability, focusing on the compensation for the injured party and the means by which this liability can be mitigated. However, he did not address the insurance against this liability. Furthermore, his study focused specifically on Saudi law.

Kumbhar et al. (2025) demonstrated that smart medical robots have played a pivotal role in transforming the healthcare sector by improving diagnostic accuracy and optimizing workflow efficiency within healthcare institutions. The study further showed that these robots can facilitate early disease detection, the development of personalized treatment plans, and support evidence-based clinical decision-making, thereby enabling highly precise surgical procedures. The researchers also identified several challenges requiring careful attention, including the protection of data privacy and ethical considerations. However, the study did not address the potential civil liability arising from medical errors caused by these robots, nor the issue of insurance coverage for such liability.

Due to their minimally invasive nature, robotic procedures can facilitate accelerated patient recovery and reduced hospital stays, thereby contributing to a potential decrease in overall healthcare expenditures. This observation is supported by Beyaz et al. (2025), who provided a comprehensive review of the developments, challenges, and prospective trajectories of artificial intelligence and robotic surgery in clinical medicine. The authors highlighted that artificial intelligence has demonstrated notable success in image processing, particularly within radiology and pathology, and has played a significant role in supporting evidence-based clinical decision-making. Nevertheless, Beyaz et al. identified persistent challenges, including regulatory constraints, limited accessibility to clinical data, and high implementation costs. They further noted that, to date, robotic surgery has not demonstrated substantial superiority over conventional surgical techniques in terms of cost-effectiveness and procedural efficiency. Notwithstanding these limitations, it is arguable that the integration of robotic surgery across multiple clinical disciplines may evolve from a mere innovation to an indispensable component of fu-

ture healthcare systems. Critically, the study did not examine the civil liability implications arising from errors committed by smart medical robots, nor did it address the legal and practical considerations associated with obtaining insurance coverage for such liability – issues that are increasingly central to the responsible deployment and regulation of autonomous medical technologies.

De Micco et al. (2025) further explored the integration of AI-enabled robots in healthcare, highlighting their transformative potential in diagnosis, treatment, and rehabilitation. The researchers demonstrated that, while these technologies offer considerable benefits such as precision, efficiency, and improved accessibility, they also raise significant ethical and legal challenges, particularly with respect to medical liability and accountability in cases of malpractice. They noted that the concept of granting 'electronic personhood' to robots and AI systems is highly debated, given the associated legal and moral hazards. Their study emphasized the necessity of human oversight in AI-driven healthcare to ensure ethical decision-making and accountability. Furthermore, it critiqued existing European regulations for leaving gaps in liability frameworks and called for specific legislative measures to address medical malpractice involving robotics and AI. The authors argued that a balanced approach is required to maximize the benefits of these technologies while safeguarding patient rights and ensuring equitable distribution of liability. From our perspective, we contend that implementing mandatory insurance represents the most effective means to achieve this balance, as will be discussed below.

These healthcare-specific concerns reflect a broader doctrinal debate within legal scholarship regarding the foundations of liability in the age of autonomous systems. The concept of electronic personality and the civil liability of robots has therefore emerged as one of the most contested issues in contemporary legal theory. At its core lies a fundamental principle: civil liability can attach only to an entity recognized as possessing legal personality. Accordingly, whether smart autonomous robots should be granted some form of legal personhood has become a central concern in AI governance discourse.

Legal personality, traditionally defined as the capacity to hold rights and duties, is not confined to natural persons. Modern legal systems recognize artificial persons, such as corporations and states, for functional and regulatory purposes (Ahmad, 2022). This doctrinal flexibility has prompted scholars to consider whether a comparable status might be extended to highly autonomous AI systems. As AI technologies increasingly participate in contracting, commercial transactions, decision-making processes, and medical practice, the regulatory urgency of this question has intensified.

The debate gained institutional prominence in 2016, when the European Parliament considered introducing a specific legal status for advanced autonomous robots to address complex liability issues. Proponents contend that recognizing electronic personality could facilitate clearer attribution of responsibility, particularly in situations characterized by distributed agency and reduced human control (Mustafa, 2025).

Gunkel (2023) conceptualizes electronic personality as a legal construct that would permit AI systems to bear certain rights and obligations. He emphasizes that legal personality is not a metaphysical quality grounded in human nature, but rather a socially constructed and functional instrument. Just as corporations are granted personhood to enable legal and economic coordination, AI systems could, in principle, be assigned a limited legal status if doing so enhances regulatory coherence. From this perspective, the central question is not whether AI resembles humans, but whether attributing electronic personality would advance legal and societal interests.

Despite these arguments, the dominant position in the literature remains critical. Many scholars maintain that AI systems lack the defining characteristics typically associated with personhood, including consciousness, intentionality, and moral agency (Müller, 2020; Pagallo, 2018). More significantly, critics warn that granting legal personality to robots risks creating accountability gaps by shifting responsibility away from manufacturers, developers, and operators. Existing legal frameworks – such as product liability, negligence, vicarious liability, and compulsory insurance – are therefore viewed as both normatively preferable and practically adequate mechanisms for addressing harms caused by autonomous systems.

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This critical stance is reinforced by Abdou (2026), who rejects the necessity of electronic personality notwithstanding AI's capacity for autonomous learning and decision-making. He argues that AI systems should remain classified as sophisticated objects within civil law. To address liability concerns, Abdou proposes adapting custodial liability regimes—particularly those governing objects requiring special care – so that the operator of an autonomous system is treated as its legal custodian. Given the opacity, unpredictability, and inherent risks associated with AI systems, he further advocates replacing fault-based standards with objective, risk-based liability. Under this model, operators would be held liable for damage caused by the system unless an external cause can be demonstrated. Such an approach preserves victim protection while avoiding the conceptual and doctrinal complications of attributing personhood to machines.

A crucial analytical distinction in this debate lies between legal and moral personhood. Legal personality is a functional construct that does not presuppose consciousness. Nonetheless, scholars such as Coeckelbergh (2010) and Müller (2020) emphasize that extending this construct to AI requires compelling regulatory justification. Others, including Rees (2018) and Misselhorn (2020), argue that the challenges posed by autonomous systems are more effectively addressed through refined risk-distribution mechanisms and regulatory adaptation rather than through the creation of a new category of electronic persons.

More expansive proposals, however, continue to emerge. Ekici (2025) advances the concept of Integrated Personality (InPer), suggesting that certain highly advanced AI systems – particularly those demonstrating human-level intelligence, autonomy, and self-awareness – could qualify for a novel legal status. Similarly, Alexander et al. (2025) distinguish between two conceptual models: AI as a fictional legal person, analogous to corporations and designed primarily for liability management, and AI as a non-fictional legal subject possessing genuine legal identity. The latter approach would entail recognizing AI as a rights-bearing entity in its own right, representing a far more radical shift in legal doctrine. As the authors note, the selection between these models will significantly influence the trajectory of AI regulation and the coherence of future legal systems.

Historically, expansions of legal recognition have often encountered initial resistance before gradual normalization. While critics continue to characterize robots as mere tools or warn of adverse social consequences, pragmatic scholars such as Ziemianin (2021) and Gunkel (2023) argue that such concerns may be overstated. Legal personality is a regulatory technique rather than a moral endorsement and does not necessarily entail the attribution of full human rights. Ziemianin therefore proposes a limited and carefully circumscribed form of electronic personality as a functional regulatory instrument, without equating AI systems with natural persons.

Ultimately, the debate suggests that legal personality for smart robots is best understood as a relational and pragmatic construct rather than an intrinsic attribute. Conferring legal personhood on AI systems may serve objectives such as enhancing economic efficiency, allocating risk, and clarifying liability, without implying moral status. The widely cited example of Sophia – granted Saudi citizenship in October 2017 and subsequently named the United Nations Development Programme's first Innovation Champion – illustrates the symbolic dimension of this discussion (Pagallo, 2018). Yet symbolic recognition does not resolve the underlying doctrinal challenge. The decisive question remains whether electronic personality genuinely improves accountability and regulatory coherence, or whether existing liability frameworks offer a more principled and effective solution.

Notwithstanding the breadth of the existing debate, the literature reveals a significant gap. To date, limited scholarly attention has been devoted to the role of civil liability insurance in addressing harm caused by AI-enabled medical robots, particularly within the framework of UAE law. Most studies have concentrated either on theoretical questions of legal personality or on general liability regimes, without undertaking a systematic examination of insurance-based solutions for healthcare robotics under the UAE legal system.

This gap underscores the significance of the present study. By analyzing the issue in light of UAE

legislation, this research seeks to determine who bears responsibility for compensating damage caused by AI-powered medical robots and to assess the feasibility of insuring against civil liability arising from their errors. The scarcity of focused scholarship further highlights the need to examine the underlying theories of civil liability applicable to medical robots and to evaluate the broader implications of mandatory insurance for both injured parties and the insurance sector. In doing so, this study aims to establish a foundational legal framework that may guide future research in this emerging field. Although direct references on this specific topic remain limited, the analysis draws upon comparative studies from other Arab jurisdictions as well as relevant foreign legal scholarship.

2. METHOD

This study adopted a descriptive approach to outline the current applications of medical robots and the basis of their civil liability and insurance. It also employed an analytical approach to examine and discuss the relevant UAE legal texts regulating civil liability for damages caused by medical robots, evaluating their effectiveness in compensating affected parties and clarifying the potential legal characterization of virtual medical robots. The study draws on a wide range of sources, most notably UAE legislation, including Civil Transactions Code No. 5 of 1985 (CTC 1985) and its amendments, and Medical Liability Law No. 4 of 2016 (MLL 2016), as well as scholarly opinions presented in books and journal articles. Additionally, it relies on governmental documents, judicial rulings, annual reports from insurance companies, law dictionaries, electronic resources, and other relevant materials, alongside the researcher's own analysis and interpretations.

3. RESULTS AND DISCUSSION

3.1. Legal theories governing civil liability of medical robots

Four primary legal theories can serve as a basis for establishing the civil liability of medical robots.

3.1.1. Theory of custody of objects

Section 316 of the CTC 1985 stipulates that 'anyone who has at his disposal objects that require special care to prevent damage, or mechanical machines, shall be liable for any damage caused by these objects or machines, except for damages that cannot be prevented'. The logic of this section affirms that the custodian's liability for objects is presumed; liability is initially imputed to the custodian unless he proves that the damage is unavoidable (Jawabi, 2022). According to this theory, damage caused by a mechanical machine or an object under custody is caused by a fault on the part of the person entrusted with the custody (Dubai Court of Cassation, 2024, Judgment No. 562). Consequently, the injured party is exempt from proving this presumed fault, as it is established by its mere occurrence (Al-Jundi, 2023).

Therefore, two elements must be present to deal with custodianship: the physical element that enables the custodian to use, direct, control, and monitor the thing, and the moral element that enables the custodian to exploit the thing for his benefit. Furthermore, for his liability to be established, the subject of custodianship must be a thing or machinery that requires special care, and damage must be caused by that thing (Ibrahim, 2018).

In this sense, a medical error is a medical robot's failure to comply with accepted medical standards and principles, deviating from the professional standards and procedures recognized by the medical community. This error may occur during diagnosis, surgery, anesthesia, treatment prescription, or monitoring and follow-up (Shaima, 2024).

This theory treats smart machines as objects in the traditional sense, and not as persons. It relies on the idea of physical custodianship, which contradicts the nature of smart medical robots that operate using AI technologies and closely resemble human nature in terms of thinking, independence, and self-determination. This makes it difficult to argue that a robot is merely an object that requires the care of another person and is subject to custodianship (Qadah & Mu'ammar, 2018; Ahmad, 2022). Consequently, this may ex-

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clude smart medical robots from the scope of application of this theory, making it impossible to find a party responsible for their actions, resulting in the loss of patients' rights.

3.1.2. Theory of principal liability for the acts of the subordinate

Section 313 of the CTC 1985 stipulates that the principal is liable if he 'has the authority to supervise and direct the person who caused the harm, even if the person was not free to choose, and if the harmful act was committed by the subordinate during or as a result of the performance of his duties'. Thus, the principal's liability for the acts of his subordinates arises if one of their subordinates commits an act that harms a third party. In this case, the injured party has the right to claim compensation from the subordinate and principal, as they are jointly liable to compensate for the harm caused. However, for this liability to arise, there must be a subordinate relationship between the subordinate and the principal – the subordinate is subject to the directives and supervision of the principal in accordance with the principal's actual authority over him, and the subordinate must commit an error during or as a result of the performance of his duties (Al-Jundi, 2023).

Although this theory applies to natural or legal persons who qualify as subordinates, it may be difficult to apply it to an autonomous smart medical robot that can perform its functions independently and without direct human control (Dagher, 2023; Mustafa, 2025). We cannot apply the concept of a subordinate to a smart medical robot because it does not have a legal personality and does not currently have an independent financial status.

3.1.3. Human agent theory

This theory is based on the premise that a robot is neither inanimate nor an object, nor an irrational being. Therefore, the human agent is responsible for its actions. The European legislator adopted this theory under the Civil Law Rules on Robotics of 2017 with the aim of obligating a person to bear liability for compensating those harmed by errors caused by the robot. These individuals may be the manufacturer, operator, owner, or user (Ahmad, 2022).

The European legislator's adoption of the term 'human agent' to distinguish it from 'custodian' implies an acknowledgement of the legal capacity of robots, which the legislator described as machines with human-like logic that are inherently evolving and designed to serve humanity (Fouad, 2020). Thus, the European legislator placed smart robots in an intermediate position between material objects and non-rational beings on the one hand, and humans on the other (Abdullah, 2021; Dagher, 2023).

This theory combines the concept of agency with the principle of civil liability applicable to robots, thereby creating a new type of agency–an agency in liability. This was not provided for in legislation (Al-Qussi, 2018; Mustafa, 2025). Furthermore, errors may occur not owing to defects in manufacturing, programming, or use but because of viruses or technical malfunctions that affect the integrity of the robot's decisions and cause it to operate unexpectedly.

3.1.4. Defective product theory

The European legislator adopted this theory under the Product Liability Directive 85/374/EEC, which states that 'the producer shall be liable for damage caused by a defect in his product' (Art. 1). This means that the producer is held liable for damage resulting from a defective product, regardless of whether the producer is in a contractual relationship with the injured party. The purpose of this approach is to relieve the injured party from the burden of proving personal fault or machine malfunction, requiring only proof that the damage resulted from a defective product (Ahmad, 2022).

For this liability to be established, the product must be defective, not provide safety and security to consumers, or pose risks to safety. The product must also be placed in circulation or on the market (Mu'ammar, 2018). Hence, some researchers base liability for damages caused by a robot on the basis that it is a defective product (Khaled, 2022). However, this theory has been criticized due to the difficulty of considering AI as a product that falls within the definition of a product stipulated in Article 2 of the 1985 Directive, which states that 'for the purpose of this Directive, 'product' means all movables, with the exception of primary agri-

Table 1. Number of insurance companies in the UAE providing coverage for civil liability arising from errors caused by smart medical robots

Source: Orient Insurance Company Book, October 2025.

Year	Number	Location
2020	2	Dubai, Abu Dhabi
2021	3	Dubai, Abu Dhabi, Sharjah
2022	5	Dubai, Abu Dhabi, Sharjah, Ajman
2023	5	Dubai, Abu Dhabi, Sharjah, Ajman
2024	8	Dubai, Abu Dhabi, Sharjah, Ajman, Fujairah
2025	10	Dubai, Abu Dhabi, Sharjah, Ajman, Fujairah, Ras Al-Khaimah

cultural products and game, even though incorporated into another movable or into an immovable'.

This excludes smart medical robots from the definition because they are considered intangible objects (Sordin, 2020; Mustafa, 2025). Furthermore, proving a defect in a product is a difficult task for the injured party, given the difficulty in distinguishing between the source of the damage and whether it results from autonomous AI capable of making its own decisions, or a defect in the robot's body or programming system (Qadah & Mu'ammar, 2018). Consequently, this theory is not valid as a basis for smart-robot liability (Al-Qussi, 2018; Mustafa, 2025).

In light of the foregoing analysis, it becomes evident that the theories established under the general provisions of the UAE Civil Transactions Code 1985 and the relevant European Union legislation are inadequate to constitute a comprehensive and coherent basis for regulating civil liability arising from damage caused by medical robots operating with artificial intelligence. Accordingly, it becomes necessary to seek alternative approaches that achieve a balance among the responsibilities of the designer, producer, and user of medical robots. One approach is adopting the principle of strict liability, whereby liability is established upon the occurrence of damage without requiring proof of a fault, holding the manufacturer, programmer, and user accountable for any harm caused to third parties by the robots' actions (Li et al., 2019; Ahmad, 2022; Mustafa, 2025).

Another approach involves reconsidering and reforming the legal framework governing the liability of smart medical robots, including the enactment of specific and clear legislative provisions to clarify their legal status (Al-Khatib, 2022). Additionally, each smart robot should possess an electronic identity, comprising a digital sequence, identification number, and a black box containing all relevant operational information, in line with Article 1/4 of the European Union's Convention on Roboethics 2025, which mandates that all robots must be designed with protected serial and identification numbers. Finally, imposing mandatory civil liability insurance for damages caused by smart medical robots is recommended, as the insurance system has proven effective in protecting affected parties.

This highlights the need for a compensation system that helps victims obtain compensation from a financially solvent entity, namely, the civil liability insurance system. The following table indicates that the number of insurance companies providing coverage for medical malpractice involving smart robots remains limited. Although there has been a gradual increase, it is still below the desired level, which may be attributed to the absence of a mandatory insurance requirement.

3.2. Legal personality and mandatory insurance as complementary mechanisms of liability

In light of the shortcomings identified in the preceding liability theories, granting smart medical robots a form of legal personality may constitute a viable and coherent solution. Such recognition would provide a clear juridical basis for attributing liability directly to these systems, particularly when they operate autonomously and without immediate human oversight. Conferring a limited legal personality would enable smart medical robots to acquire rights, assume obligations, and, crucially, maintain an independent financial status capable of supporting the attribution and enforcement of civil liability.

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According to Sections 71 and 92 of the CTC 1985, legal personality can be either natural, established for a natural person born alive, or legal, established for a group of entities or persons recognized by law, such as companies and associations. In this regard, it is not possible to concede that a robot is a natural person, given that it was not born alive. Some researchers oppose granting legal personality to robots, arguing that granting such a personality could lead to ignoring the liabilities of manufacturers, programmers, and users, leading to their failure to adhere to quality and accuracy specifications when manufacturing and using them, making them extremely dangerous. Furthermore, robots do not possess the willpower that humans possess, and have not yet reached the level of full autonomy or the stage of deep learning (Balhadj, 2023).

This approach argues that granting robots a legal personality would entail granting them other rights, such as freedom of expression, work, equality, property ownership, and marriage, undermining human values (Al-Khatib, 2018), particularly because robots lack feelings of fear, joy, happiness, anger, compassion, respect, intention, faith, and morality because they simply lack a soul (Ahmad, 2022). It also argues that recognizing robots as legal persons could give rise to a non-human society vested with rights and obligations, which may undermine the rule of law and resist adherence to its established regulations (Dagher, 2023; Mu'tasem, 2024). It further believes that a robot, from a legal perspective, is a thing and that the solution to problems that arise as a result of the damages it may cause is through a mandatory insurance system (Abdullah, 2021). This approach is adopted by some courts in the United States, which have traditionally deemed it impossible for machines to bear legal liability, as they are not legal persons (Chung & Zink, 2018).

Conversely, some researchers have argued for the necessity of recognizing the legal personality of smart robots, arguing that the basis for establishing liability is perception, which is available in a smart robot capable of adapting to its surrounding environment (Khaled, 2022). They believe that the goal of granting legal personality to a robot is not to enjoy full human-like rights but rather to determine who is responsible for any harm it causes, protecting those who interact with it, and achieving the interests of society (Tahani, 2022).

To reconcile these two perspectives, some researchers believe that recognizing the legal personality of a smart robot is acceptable as long as it remains subject to human control (Al-Ma'dawy, 2021; Mustafa, 2025). This ensures that human law remains the prevailing law—the robot's legal personality should not be fully recognized, but a hypothetical, incomplete legal personality, similar to the stage of indiscernibility in humans (Fouad, 2020). In our opinion, this is the correct view, and we suggest that the UAE legislator consider it.

UAE law does not address the legal regulation of the use of smart medical robots, nor has it yet recognized their legal personality. It states that there are two types of legal personalities (natural and legal), neither of which applies to robots. Therefore, a robot is considered a physical object in the eyes of a legislator, and a person with the authority to direct and control it is responsible for it under the responsibility of the custodian of the object (Tahani, 2022).

However, the reality dictates that the UAE legislator must keep pace with the technological development of AI, which is currently witnessed worldwide. This necessitates, sooner or later, recognizing the legal personality of intelligent robots that operate autonomously in decision-making (Abdulrazzaq, 2022; Al-Ma'dawy, 2021). It appears that the UAE legislator is moving in this direction, especially in light of the establishment of a new Ministry of AI, and in light of what happened in the Kingdom of Saudi Arabia, which granted Saudi citizenship to the robot '*Sophia*' designed by Hanson Robotics to work with humans and mimic human behavior, making it the first robot to receive citizenship (Ahmad, 2022; Mustafa, 2025). This is no longer unusual, as South Korea has recognized the legal personality of smart robots and imposed obligations on them, making them legally liable in the event of their failure to comply with the rules stipulated by the law (Ahmad, 2022).

Moreover, granting smart medical robots a legal personality enables them to bear legal obligations, acquire rights, and enjoy an independent financial status, enabling them to bear financial obliga-

tions resulting from errors if they are solvent. If insolvent, the injured party could resort to a human agent. This is a principle that the UAE legislators should adopt, particularly in light of the growing reliance on robots in the medical field, as evidenced by a significant milestone achieved by the healthcare sector in the United Arab Emirates this year, with 8 local hospitals included in the list of the World's Best Smart Hospitals for 2026, issued by Newsweek magazine in cooperation with Statista (Emirates News Agency, 2025). This global ranking, which encompasses 350 hospitals across 30 countries, confirms the UAE's leading position in the field of smart healthcare and reflects its growing reliance on the latest medical innovations, including smart medical robots equipped with AI technologies.

The statistics released by Emirates Health Services illustrate a steady and consistent increase in the number of smart hospitals in the UAE between 2020 and 2025. In 2020, the country recorded five smart hospitals. This number rose to eight in 2021 and nine in 2022, reflecting gradual initial expansion. Growth accelerated thereafter, reaching twelve smart hospitals in 2023. The upward trajectory continued more markedly in 2024, with the number increasing to sixteen, and further expanding to eighteen by 2025. Overall, the data demonstrate a clear and sustained commitment to digital transformation in the UAE healthcare sector, as the number of smart hospitals more than tripled over the six-year period (Emirates Health Services, 2025).

This rapid expansion is not merely a technological development; it carries significant legal and regulatory implications. As healthcare institutions increasingly integrate AI-powered systems and robotic technologies into clinical practice, the potential for technologically induced errors correspondingly increases. The accelerated growth of smart hospitals, therefore, reinforces the urgency of establishing a clear civil liability framework and, more importantly, a structured and possibly mandatory insurance regime capable of addressing risks associated with AI-enabled medical robotics. Without such regulatory adaptation, the legal system may struggle to ensure adequate compensation for patients while maintaining stability within the healthcare and insurance sectors.

Until the legal personality of smart medical robots is recognized, we believe that UAE legislators must establish rules and regulations governing their operation, including the creation of a special registry to record all information related to each robot and the adoption of a special insurance system against the risks caused by them. Until this happens, we believe that it is necessary to consider smart robots as objects requiring special care to which the theory of custodianship applies, which constitutes the basis for establishing civil liability. In this regard, the Legal Affairs Department of the Dubai Health Authority adopted the idea that a medical robot is considered a device operated by its user or programmer. It is believed that the liability falls on the robot's manufacturer in the event of a defect, on the healthcare facility in the event of a defect in the devices connected to it, or on the physician controlling and directing its use (Khalil, 2025).

Therefore, the most effective solution is to grant smart medical robots a legal personality, enabling them to possess an independent financial status and assume financial obligations arising from their errors, which in turn paves the way for imposing mandatory insurance to cover civil liability for damages caused by such errors.

In this context, civil liability insurance for medical errors is considered a form of damage insurance that compensates for harm to a person's financial position resulting from their civil liability for injury caused to others (Blosh, 2022). It seeks to balance the physician's need for professional freedom, trust, and protection from occupational risks with the imperative of safeguarding patients' lives and physical integrity from the consequences of medical practice (Shaima, 2024).

As the UAE MLL 2016 does not specifically define medical liability insurance, the general concept of an insurance contract is instead set out in Section 1026 of the Civil Transactions Code 1985, which describes it as a contract whereby the insured pays premiums to the insurer in exchange for compensation upon the occurrence of an insured risk. In the absence of a specific legislative definition, legal scholars have defined physicians' civil liability insurance as a contract under which a physician insures against liability for damages suffered by

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patients due to medical errors in return for agreed premiums (Fawaz & Ali, 2021), or as insurance covering damages sustained by patients or other affected third parties as a result of acts giving rise to the physician's liability (Mu'tasem, 2024). This insurance is distinguished by the involvement of a third party – the injured claimant – who, although not a party to the insurance contract, seeks compensation for the harm suffered (Blosh, 2022); the insured risk materializes when a compensation claim, whether amicable or judicial, gives rise to the physician's obligation to pay damages (Al-Qurashi, 2023).

In light of this framework, and notwithstanding the absence of a statutory obligation to insure against liability arising from the harmful acts of AI-operated medical robots, the UAE legislator has adopted a mandatory insurance approach in relation to other AI-operated entities – self-driving cars. Section 8/1 of Dubai Autonomous Vehicles Act No. 9 of 2023 stipulates that 'to license an autonomous vehicle, it must be insured with an insurance company licensed to operate in the country'. The legislator has also applied this requirement to AI-based transport systems such as the Dubai Metro. Section 10 of the Executive Council Resolution No. 1 of 2014 Regulating the Tram in Dubai stipulates that 'the owner must provide a comprehensive insurance policy acceptable to the Authority, in accordance with its approved conditions, issued by a licensed insurance company, to ensure compensation for any damages that may be incurred by third parties'.

The UAE legislator also stipulates an obligation to ensure civil liability arising from the practice of the medical profession. Section 25 of the MLL 2016 stipulates that 'it is prohibited to practice the profession in the UAE without insurance against civil liability for medical errors with one of the insurance companies licensed in the country'. This is a commendable position on the part of the legislator, as mandatory insurance enhances the ability to compensate individuals harmed by medical errors and achieves a degree of shared responsibility for medical liability, given that medical errors are not limited to doctors alone, but can be caused by any healthcare provider, such as anesthesiologists, nurses, laboratory technicians, and others.

However, the Medical Liability Law was not sufficiently clear to hold insurance companies liable for damages arising from the use of smart medical robots. Consequently, insurance companies may argue that they do not consider a medical robot as a machine, unlike other surgical instruments or tools such as scissors and endoscopes. This issue becomes more complicated when a medical robot performs comprehensive surgical procedures without the supervision and guidance of a surgeon, and in accordance with its own software. This leads to a lack of protection for the affected patients.

Therefore, clarifying the legal status of smart medical robots under UAE law and providing legislative treatment to define their legal personality are crucial, particularly regarding civil liability insurance for harmful actions. The UAE legislator may intervene in the future for regulatory and societal considerations and recognize their full legal personality, or at least create a special legal treatment that shifts them from the realm of things to the intermediary space between things and people, at least for the time being. This will pave the way for imposing mandatory insurance for civil liability arising from robotic errors as a subsequent step.

In light of the foregoing, the general principle of mandatory medical civil liability insurance adopted by the UAE legislator provides a suitable legal foundation for extending this requirement to smart medical robots. Such an extension is justified by several considerations. The integration of smart medical robots into healthcare has increased the risks associated with medical practice, particularly as these robots are capable of performing complex surgical procedures whose adverse consequences may result in significant harm to patients (Fawaz & Ali, 2021). Patient protection further necessitates this extension, since obtaining compensation for damage caused by robotic errors may prove difficult if the robot is recognized as an independent entity. In such cases, the injured party may face challenges in establishing fault and may consequently be deprived of compensation. Even where recourse is sought against the physician or hospital operating the robot, insolvency may hinder effective recovery (Mu'tasem, 2024). Mandatory insurance would therefore ensure the existence of a solvent entity from which compensation can be secured.

Extending mandatory insurance also serves to protect the insured party, namely, the smart medical robot if recognized as a legal entity. Such insurance safeguards the insured's financial assets from claims arising from compensation owed to third parties, as liability insurance shifts the financial burden of compensation to the insurer, which may still impose a deductible ratio on the robot or the hospital (Maysoum & Ackley, 2018). Beyond individual protection, mandatory insurance yields significant societal benefits. When insurance companies specialize in medical civil liability insurance, they develop extensive expertise and accumulate data and statistics that help identify the causes and factors contributing to compensable medical errors, thereby helping to reduce their occurrence (Shaima, 2024). Moreover, civil liability insurance for smart medical robots stimulates investment in this type of insurance and strengthens the insurance sector as a whole (Blosh, 2022). This, in turn, contributes to national economic growth and increases the gross national product through rising financial inflows generated by insurance premiums.

It should be noted that there are several categories developed by the insurance economics literature, the most significant of which are moral hazard and adverse selection. Moral hazard occurs when insurance seekers engage in riskier or less cautious behavior, relying on the fact that the negative consequences of their actions will be borne by another party, namely the insurance company. Consequently, the incentive to fully bear responsibility is reduced, increasing the likelihood or severity of a loss due to the insured person adopting more reckless or negligent behavior. This creates an information gap, as the insurer cannot fully monitor the behavior of the insured, allowing undesirable conduct to occur without the insurer's knowledge. It also results in a misalignment of behavior between the parties after the contract is concluded, as the insured may reduce their diligence in adhering to usage rules or increase exposure to risk once coverage is obtained (Shukri, 2022; Blosh, 2022). However, this can be mitigated through mechanisms such as deductibles, which represent a portion of the loss borne by the insured, thereby incentivizing greater caution; providing premium discounts to insured parties who demonstrate safe behavior; establishing clear contractual conditions to limit risky conduct and reinforce responsibility; and employing technology to monitor behavior to assess risks more accurately (Baldawi, 2020).

Adverse selection is a situation that occurs when insurance applicants possess more information about their actual risk levels than the insurance company. This asymmetry may lead higher-risk individuals to disproportionately purchase insurance, resulting in increased claim costs and forcing insurers to raise premiums for all policyholders, including lower-risk individuals, thereby reducing the attractiveness of the market. Additionally, lower-risk individuals may withdraw from the market, ultimately increasing losses for the insurance company (Musa, 2020; Blosh, 2022). However, this can be mitigated by requiring insurance applicants to provide full disclosure of their risk levels or by offering insurance coverage at lower costs, which entails the use of risk-based categories and differential pricing. It can also be managed through the inclusion of exclusion clauses in contracts to reduce unbalanced risk exposure, or by providing discounts or benefits to lower-risk individuals to promote market equilibrium (Baldawi, 2020; Shukri, 2022).

In this context, civil liability based on the principle of risk distribution and sharing, which considers all issues encompassed by moral hazard and adverse selection, can play a positive role in improving the performance of the insurance market, particularly in the case of mandatory insurance against civil liability of smart medical robots. It is believed that this can be achieved through the adoption of strict liability, coupled with the imposition of a deductible or risk-sharing requirement on insurance applicants. Strict liability implies that a party can be held liable for damages caused by smart medical robots, regardless of proof of fault or negligence. Operators may not exonerate themselves by asserting that they exercised due diligence or that the damage was caused autonomously by the robot. In other words, healthcare organizations are liable for harm irrespective of fault. Nevertheless, liability may be excluded where they are able to demonstrate that the harm resulted from a fortuitous event (Ahmad, 2022; De Micco et al., 2025).

http://dx.doi.org/10.21511/ins.17(1).2026.02

In such cases, the injured party should have direct recourse to the insurance company, which may impose a deductible on healthcare providers and set maximum compensation caps for bodily injuries, material damage, and property damage. To prevent excessive financial burdens on insurers and to mitigate harm arising from the acts of smart medical robots, the legislator is encouraged to intervene by reducing tax burdens on insurance companies and by establishing a clear limitation period for compensation claims in insurance disputes. Furthermore, the Emirates Insurance Federation can contribute positively by monitoring the performance of insurers providing civil liability coverage and by offering technical support and advisory services, thereby enhancing the efficiency, stability, and sustainable growth of the insurance sector.

Some may argue that imposing mandatory insurance on hospitals and healthcare centers that employ smart medical robots would increase the cost of healthcare services and, consequently, raise medical service fees, thereby placing an additional financial burden on consumers/patients. Moreover, such a requirement could lead to a reduced use of robots in the medical field. While this view has a certain degree of merit, the objectives and advantages of insurance are equally well-founded. Insurance serves to protect the rights of injured parties and to safeguard the public interest, while also encouraging hospitals and healthcare institutions to exercise due care and diligence and to exert their utmost efforts in providing high-quality medical services.

This, in turn, would reduce the risks associated with the use of such robots, create greater legal certainty, and consequently diminish the likelihood of medical errors, particularly if the Emirates Authority for Standardization and Metrology (ESMA) were to establish stringent standards governing the specifications of medical robots and require manufacturers and suppliers to comply therewith and to ensure that their products are warranted for extended periods. Such measures would, in themselves, compel manufacturers and suppliers to make every effort to provide hospitals and healthcare centers with intelligent robots of high technical specifications. All of this would create indirect cooperation with insurance companies and would thus contribute to enhancing consumer satisfaction and promoting the growth and prosperity of the insurance sector.

This is consistent with the provisions of the EU Artificial Intelligence Act 2024**,** which obliges producers to comply with the specifications set out therein and, in the annexes, attached thereto. The Act further requires producers to provide a detailed description of the elements of the AI system, including: the design specifications of the system, namely the general logic of the AI system and of the algorithms; the key design choices including the rationale and assumptions made, including with regard to persons or groups of persons in respect of who, the system is intended to be used; the main classification choices; what the system is designed to optimize for, and the relevance of the different parameters; the description of the expected output and output quality of the system; the decisions about any possible trade-off made regarding the technical solutions adopted to comply with the requirements set out in the Act (Article 2(b), Annex IV).

Arguably, mandatory insurance has a positive impact because it enhances patients' confidence in the medical practice performed by medical robots, helping relevant entities provide medical care using AI technologies without excessive fear of the financial consequences of potential errors that may arise from medical work (Jihad, 2011). It also provides comfort to patients who are hesitant about being treated by a medical robot and are concerned about placing their bodies under the control of a medical robot, feeling that it differs from humans, and lacks emotions and feelings (Ahmad, 2022). It also reduces the level of anxiety associated with legal liability, as harmed patients can seek redress from a financially solvent entity that will compensate them for any damage they may suffer as a result of the medical practice performed by the medical robot (Musa, 2020; Blosh, 2022). However, this does not exempt a smart medical robot or the entity operating it from adhering to medical and ethical standards that require avoiding harm to patients and following the medical protocols for which the robot is programmed.

A mandatory insurance contract creates a relationship between the insurer and the injured party. In the event of damage, the injured party can file an indirect lawsuit against the insurer, exercis-

ing the rights of the debtor (the insured). However, this indirect lawsuit does not provide much relief to the injured party, as the insured's other creditors share the resulting proceeds (Musa, 2020). Therefore, the injured party must have a direct lawsuit against the insurer, becoming a creditor with a lien on the claimed rights (Shaima, 2024). The UAE legislator has provided for this lawsuit in vehicle insurance, as stipulated in Section 19 of Traffic Law No. 14 of 2024, and there is no objection to stipulating it.

Nevertheless, insurance may negatively affect professional medical practices. Insurance may sometimes cause hospitals operating medical robots to be lax, not fully comply with medical procedures, or abandon certain necessary preventive measures, negatively impacting the quality of healthcare (Shaima, 2024). This may also lead to a false sense of security, as hospitals and medical centers believe that they have a safety net to protect them from the financial consequences of any potential error. This can lead to a lack of attention to detail or careful preparation before performing surgical procedures (Mu'tasem, 2024). Some patients may also feel anxious when they know that the medical robot and the hospital operating it are insured against civil liability, which may raise doubts about the extent of their commitment to providing high-quality care (Munther, 2022). However, we believe that, while insurance aims to protect hospitals and operators of smart medical robots from the financial consequences of unintentional errors, it must not lead to complacency or diminished vigilance. The existence of insurance coverage should never justify reduced attention to professional duties. On the contrary, strict adherence to high medical standards and the safeguarding of patient safety must remain paramount.

In this context, it is noteworthy that no separate statistics are currently available from the Emirates Insurance Federation regarding the share of civil liability insurance specifically covering smart medical robots within total insurance premiums. This absence of data further underscores the emerging and underdeveloped nature of this field within the broader insurance framework.

Although specific figures are unavailable, data on the overall distribution of insurance premiums by category for 2024 provide valuable contextual insight. Health insurance constitutes the largest segment of the UAE insurance market, accounting for 48.1% of total premiums and clearly dominating the sector. Motor vehicle insurance follows at 12.4%, reflecting its status as a compulsory line of coverage, while life insurance represents 11.5% and fire insurance accounts for 9.6%. Property insurance contributes 6.3% of total premiums, whereas civil liability insurance comprises only 3.5%, making it one of the smaller segments within the overall distribution. The remaining 8.6% falls under other insurance categories (Orient Insurance Company Book, 2025; Atlas Magazine, 2024). Overall, the data demonstrate a marked concentration in health insurance, which alone represents nearly half of the market, in contrast to the comparatively limited share occupied by civil liability insurance.

The data further indicate that civil liability insurance constitutes the smallest share among the principal insurance categories. Notably, this percentage encompasses civil liability coverage for human professionals – such as physicians, lawyers, architects, and certified public accountants – rather than policies specifically designed for AI-enabled medical robots. This finding underscores the relatively marginal position of civil liability insurance within the overall market and, more importantly, reveals the absence of a dedicated insurance framework addressing emerging technological risks associated with autonomous medical systems.

The study produced several key findings. It revealed that several criticisms have been directed at the existing theories used to establish the liability of medical robots for the harm they may cause, prompting proposals for alternative approaches such as registration mechanisms, mandatory insurance, and the adoption of strict liability based primarily on the occurrence of damage. The study also found that the recognition of full legal personality for smart medical robots remains a contested issue and has not yet been formally acknowledged. Furthermore, it became evident that harm caused by a medical robot may arise from manufacturing or programming defects, or from factors inherent to the digital environment, including viruses and technical malfunctions. However, when a human

http://dx.doi.org/10.21511/ins.17(1).2026.02

physician intervenes by issuing orders or instructions to the robot, the physician is deemed liable for any resulting harm under the rules governing the liability of the custodian of things set out in Section 313 of the CTC 1985. The manufacturer, by contrast, bears responsibility for all damage arising from defects related to the robot's construction or internal systems.

The study further demonstrated that the purpose of medical civil liability insurance is to cover damages incurred by the insured due to civil liability claims filed by third parties, noting that such insurance is strictly limited to civil liability and excludes other types. It was also found that the UAE legislator has not yet regulated liability arising from damages caused by medical robots within the MLL 2016 or any other legislation, leaving a legal gap in this domain. Despite this, civil liability insurance for medical robots was shown to offer significant benefits that outweigh potential drawbacks. Finally, the study confirmed that direct legal actions are the most effective mechanism for enabling injured parties to file claims directly against insurance companies for medical errors committed by robots, thereby facilitating more efficient access to compensation.

Based on these findings, the study proposes several recommendations. First, the civil liability provisions of the CTC 1985 concerning custodians of mechanical devices and objects requiring special care should be amended to explicitly include robot designers, operators, and users, under clear and comprehensive rules. Medical robots that possess AI technologies are no longer merely machines, but have been designed and developed to mimic humans; they fall somewhere between machines (inanimate objects) and humans. This requires legislative intervention that reconsiders the legal frameworks regulating them and defines the scope of their liabilities, rights, and obligations, especially given their intelligence, which enables them to comprehend the laws and programs themselves and operate in accordance with them. The study further recommends that the UAE legislator enact specific legislation addressing AI in general and smart medical robots in particular, defining their legal identity, ensuring protection against harm, mandating registration through a competent authority under defined standards, and establishing a national charter articulating the principles and ethics of AI use.

Given that an insurer's obligation to compensate currently depends on proving the insured's liability toward the injured party, a provision should be introduced granting the injured party a direct right of action against the insurer. Accurate documentation of medical errors involving smart medical robots should be maintained as a reference for future evaluation studies. Moreover, autonomous AI-powered medical robots should be granted a separate, though limited, legal personality recognizing their independent financial status and enabling them to bear civil liability for harmful actions, reflecting the approach recommended by the European legislator. Finally, civil liability insurance for medical errors caused by independently operating smart medical robots should be made mandatory to ensure justice and safeguard affected parties, with owners, manufacturers, or operators responsible for premiums until the robots attain full legal personality.

CONCLUSION

The purpose of this study is to examine the necessity of introducing mandatory civil liability insurance for AI-operated medical robots in the United Arab Emirates to ensure effective patient compensation and to establish a coherent legal framework governing liability. The study finds that the existing legal theories under UAE law are inadequate to effectively regulate civil liability arising from harm caused by smart medical robots, thereby exposing a significant legislative gap. These robots are currently classified as objects, as they do not satisfy the requirements for acquiring either natural or legal personality. Consequently, liability is imposed on the robot's custodian, provided that the custodian exercises actual control over the robot in terms of direction and supervision. This approach applies both to traditional robots that lack autonomous decision-making capabilities and to smart robots when they are not operating independently.

This classification reflects the broader legislative model adopted in the UAE for other AI-operated systems. For example, Section 14 of Law No. 9 of 2023 Concerning the Operation of Autonomous Vehicles in the Emirate of Dubai provides that the operator is liable to compensate for any damage caused by the autonomous vehicle, without prejudice to the right of recourse against the actual perpetrator in accordance with the general rules of liability. Similarly, although the Dubai Metro operates using AI technologies and functions independently of human intervention, liability is assigned to the operator under Section 8(B) of Executive Council Resolution No. 1 of 2017 regulating Railways in Dubai. Likewise, Section 10 of Executive Council Resolution No. 1 of 2014 regulating the Dubai Tram places responsibility on the owner and requires the provision of comprehensive insurance coverage to guarantee compensation for third parties.

While this operator-based liability model may be appropriate for transport systems operating within structured regulatory environments, it does not fully accommodate the distinctive characteristics of autonomous medical robots. Smart medical robots represent one of the most advanced applications of artificial intelligence in healthcare, enhancing diagnostic precision, improving treatment accuracy, and increasing procedural efficiency. However, their autonomous capabilities introduce novel legal risks, particularly when harm occurs without direct human intervention.

For this reason, the study argues that treating smart medical robots merely as objects is no longer conceptually or practically sufficient. It therefore advocates granting them a limited digital legal personality, subject to clearly defined regulatory controls, in order to enable a clearer and more coherent attribution of responsibility. Each robot should be assigned a unique digital identity, equipped with a data-recording 'black box,' and incorporated into a structured regulatory framework.

Most importantly, the study concludes that mandating civil liability insurance – combined with granting injured parties a direct right of action against insurers – constitutes the most effective mechanism for ensuring fair, reliable, and accessible compensation. Mandatory insurance not only safeguards patients but also enhances legal certainty, strengthens confidence in AI-driven healthcare, and supports the sustainable development of the insurance sector.

By advancing this framework, the study makes a foundational contribution to the regulation of civil liability in the era of AI-powered medical robotics and enriches the evolving legal discourse on technological accountability in healthcare.

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