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Criminal Liability in Artificial Intelligence-Based Medical Malpractice: Normative Voids and Challenges of Modern Health Law

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ABSTRACT

This study aims to examine the construction of criminal liability in cases of medical malpractice involving artificial intelligence and to identify the normative gaps within contemporary health law that hinder effective accountability. It further seeks to formulate a responsive legal framework capable of addressing the challenges posed by the integration of advanced technologies in medical practice. The research employs normative legal methodology using statute and conceptual approaches. The statute approach analyzes existing legal provisions governing healthcare and criminal liability, while the conceptual approach explores doctrinal principles such as fault, negligence, and responsibility in technologically mediated environments. Data are analyzed using a descriptive and prescriptive method to both explain current legal conditions and propose normative solutions. The findings reveal that existing legal frameworks remain anthropocentric and are unable to adequately address the distributed nature of responsibility in AI-mediated healthcare. The absence of explicit regulations on the use of artificial intelligence creates a normative vacuum, leading to uncertainty in attributing criminal liability among physicians, developers, and healthcare institutions. The study also finds that traditional doctrines such as *mens rea* and *actus reus* are increasingly difficult to apply in cases where decision-making involves algorithmic systems. As a result, there is a need to reconceptualize criminal responsibility through more adaptive models, including shared responsibility and selective strict liability. This research concludes that legal reform is crucial to ensure accountability, legal certainty, and patient protection in the digital healthcare era. It proposes the development of integrated and forward-looking legal frameworks that align technological innovation with the fundamental principles of criminal law.

Keywords: Artificial Intelligence, Medical Malpractice, Criminal Liability, Health Law, Normative Gap.

I. Introduction

The rapid integration of artificial intelligence (AI) into healthcare systems has fundamentally transformed the landscape of medical practice, particularly in diagnostics, decision-support systems, and predictive analytics. From radiological interpretation to algorithm-assisted clinical decision-making, AI technologies increasingly function not merely as passive tools but as active contributors to medical judgment. This transformation, however, raises complex legal questions, particularly concerning criminal liability in cases



of medical malpractice involving AI systems. While traditional doctrines of medical malpractice have long been grounded in human agency, fault, and professional standards, the introduction of autonomous or semi-autonomous AI systems destabilizes these foundational assumptions and exposes significant normative gaps in contemporary health law frameworks. Existing scholarship has begun to explore the intersection between AI and medical liability, though largely within civil law paradigms. For instance, research by Price and Cohen emphasizes the inadequacy of existing tort doctrines in capturing algorithmic harm due to opacity and the distributed nature of responsibility (Price & Cohen, 2019). Similarly, Gerke, Minssen, and Cohen highlight the regulatory fragmentation in governing AI in healthcare, pointing to inconsistencies between data protection, medical device regulation, and liability regimes (Gerke et al., 2020). These studies underscore the systemic challenge of attributing liability in AI-driven medical errors but remain predominantly focused on civil liability and regulatory compliance.

In contrast, the dimension of criminal liability in AI-assisted medical malpractice remains underdeveloped. Some scholars have tentatively addressed this issue by questioning whether traditional doctrines such as negligence, recklessness, and intent can be meaningfully applied when decision-making processes involve machine learning systems that are not fully explainable (Amir et al., 2021). Others argue that the diffusion of responsibility across multiple actors, including physicians, developers, and healthcare institutions, complicates the identification of a culpable subject under criminal law (Marchant & Lindor, 2019). However, these discussions often stop short of proposing a coherent doctrinal framework for criminal accountability, thereby leaving a significant research gap. The conceptual challenge lies in reconciling the principles of criminal liability, particularly *actus reus* and *mens rea*, with the operational logic of AI systems. Criminal law traditionally presupposes a human actor capable of intent, awareness, and control. AI systems, especially those based on deep learning, operate through probabilistic reasoning and adaptive learning processes that may produce outcomes not fully anticipated by their creators or users. This raises the question of whether liability should be attributed to the physician who relies on AI recommendations, the developer who designed the algorithm, or the institution that deploys the technology. The absence of clear normative guidance in this regard creates legal uncertainty and risks undermining both accountability and patient protection.

From a conceptual standpoint, the notion of “AI-mediated medical decision making” necessitates a re-evaluation of the standard of care. Traditionally, the standard of care is defined by what a reasonably competent physician would do under similar circumstances. However, when AI systems provide recommendations that may exceed human diagnostic capabilities, the benchmark itself becomes fluid. Some scholars suggest that failure to use AI could, in certain contexts, constitute negligence, while others warn against over-reliance on algorithmic outputs that may embed biases or errors (Topol, 2019). This dual risk of underuse and overreliance further complicates the assessment of criminal culpability. The general development of AI in healthcare has also been accompanied by regulatory efforts, such as the European Union’s proposed AI Act and various national guidelines on digital health technologies. These frameworks primarily focus on safety, transparency, and risk classification but do not comprehensively address issues of criminal liability. In Indonesia and many other jurisdictions, the legal framework governing medical malpractice remains anchored in conventional medical practice, with limited provisions addressing the role of advanced technologies. This regulatory lag creates a normative vacuum, particularly in cases where AI systems contribute to adverse medical outcomes.

More specifically, the phenomenon of AI-related medical errors has begun to surface in empirical studies and case reports. Instances of misdiagnosis due to biased training data, algorithmic errors in imaging analysis, and incorrect treatment recommendations have been documented, raising concerns about patient safety and accountability (Jiang et al., 2017). In such cases, determining criminal liability becomes particularly challenging when the physician has acted in accordance with AI recommendations that are widely accepted or institutionally endorsed. The question then arises: can a physician be held criminally liable for relying on a system that is presumed to enhance accuracy and efficiency?. This issue is further complicated by the “black box” nature of many AI systems, which limits the ability of users to understand the reasoning behind specific

outputs. The lack of explainability not only poses ethical concerns but also undermines the evidentiary basis for establishing fault in criminal proceedings. As Burrell notes, the opacity of algorithmic systems creates a “transparency gap” that challenges traditional modes of legal reasoning and proof (Burrell, 2016). Without clear insight into how a decision was generated, it becomes difficult to assess whether an error resulted from human negligence, system failure, or an unforeseeable interaction between the two.

The specific legal problem, therefore, lies in the absence of a coherent framework for attributing criminal responsibility in cases of AI-assisted medical malpractice. This gap is not merely theoretical but has practical implications for legal certainty, professional accountability, and patient rights. The current legal system risks either over-penalizing healthcare professionals who act in good faith reliance on AI or under-regulating technological actors whose products may cause harm. Both scenarios undermine the fundamental objectives of criminal law, namely deterrence, retribution, and the protection of public interests. In addressing this issue, it is necessary to engage with broader theoretical debates on the nature of responsibility in technologically mediated environments. The concept of “distributed responsibility” has been proposed as a way to account for the multiple actors involved in AI systems, though its integration into criminal law remains contentious (Floridi et al., 2018). Similarly, the idea of “strict liability” for certain high-risk technologies has been مطرح as a potential solution, but this approach raises concerns about fairness and proportionality. These theoretical perspectives highlight the need for a nuanced approach that balances innovation with accountability.

This study contributes to the existing literature by focusing specifically on the criminal law dimension of AI-based medical malpractice, an area that has received limited scholarly attention. Unlike prior studies that emphasize civil liability or regulatory compliance, this research seeks to develop a normative framework for criminal accountability that reflects the unique characteristics of AI systems. By analyzing the doctrinal limitations of existing legal concepts and examining comparative approaches in different jurisdictions, this study aims to propose a reformulation of criminal liability that is both principled and adaptable. The novelty of this research lies in its integrative approach, combining doctrinal analysis with conceptual and comparative perspectives to address a pressing legal gap. It advances the argument that traditional models of individual liability must be reconfigured to accommodate the collective and technologically mediated nature of AI-driven medical practice. Furthermore, it proposes the development of hybrid liability models that allocate responsibility across different actors while preserving the core principles of criminal law. In doing so, this study not only fills a significant research gap but also offers practical insights for policymakers, legal practitioners, and healthcare professionals navigating the complexities of modern medical technologies. Ultimately, the challenge of regulating AI in healthcare is not merely a technical or regulatory issue but a fundamental question of legal philosophy and institutional design. As AI continues to reshape the contours of medical practice, the law must evolve to ensure that accountability mechanisms remain effective, just, and responsive to new forms of risk. This study represents a step toward that goal by articulating a coherent framework for criminal liability in the age of intelligent machines.

II. Literature Review and Hypothesis Development

Existing studies on artificial intelligence in healthcare primarily examine civil liability, regulatory compliance, and patient safety. Price and Cohen (2019) argue that conventional tort law is inadequate for addressing algorithmic harm because AI systems are often opaque and involve multiple responsible actors. Similarly, Gerke et al. (2020) identify regulatory fragmentation among health law, data protection, medical device regulation, and liability regimes. The criminal liability dimension remains comparatively underdeveloped. Amir et al. (2021) question whether negligence, recklessness, and intent can be effectively applied when medical decisions involve machine-learning systems that are not fully explainable. Marchant and Lindor (2019) further emphasize that responsibility is distributed among physicians, developers, and healthcare institutions, making it difficult to identify a single culpable actor. Algorithmic opacity also complicates the establishment of causation, foreseeability, and fault in criminal proceedings. Accordingly, the

present study is grounded in the concepts of mens rea, actus reus, standard of care, distributed responsibility, and strict liability. Unlike previous studies that mainly focus on civil liability, this research examines the limitations of conventional criminal law and proposes shared or layered responsibility and selective strict liability for high-risk AI applications. This approach addresses the absence of a coherent framework for allocating criminal responsibility in AI-mediated medical malpractice, particularly within the Indonesian legal system.

III. Research Method

This study employs normative legal research as its primary methodological framework, focusing on the analysis of legal norms governing criminal liability in the context of artificial intelligence based medical malpractice. The research is grounded in a statute approach and a conceptual approach. The statute approach is utilized to examine relevant laws and regulations related to healthcare practice, criminal liability, and the use of emerging technologies within medical services. Through this approach, the study identifies gaps, inconsistencies, and limitations in existing legal frameworks that have not yet accommodated the complexities introduced by artificial intelligence. In parallel, the conceptual approach is applied to explore and critically assess legal doctrines, principles of criminal responsibility, and theoretical perspectives on liability in technologically mediated environments. This approach enables a deeper understanding of how traditional concepts such as fault, negligence, and accountability can be reinterpreted in the context of artificial intelligence integration in healthcare. The data analysis is conducted using a descriptive prescriptive method. Descriptively, the study outlines the current legal conditions and conceptual challenges surrounding artificial intelligence in medical malpractice. Prescriptively, it formulates legal arguments and proposes normative solutions aimed at addressing the identified regulatory gaps, ensuring that the legal system remains responsive, coherent, and capable of safeguarding justice in modern healthcare practices.

IV. Result and Discussion

4.1. Normative Gaps in Criminal Liability for AI Based Medical Malpractice

The findings of this study reveal that the existing legal framework governing criminal liability in medical malpractice remains deeply rooted in anthropocentric assumptions that fail to accommodate the complexities introduced by artificial intelligence in healthcare. Within the Indonesian legal system, criminal liability is fundamentally premised on the existence of human conduct accompanied by fault, either in the form of intent or negligence, as reflected in the doctrinal structure of the Penal Code and its interpretative development in legal scholarship. This orientation presumes that the actor who commits a harmful act possesses cognitive awareness and control over the consequences of such conduct. However, the integration of artificial intelligence into medical practice disrupts this foundational premise, as decision making processes are no longer exclusively human but are increasingly mediated by algorithmic systems that operate beyond the full comprehension of their users. Consequently, the classical construction of liability becomes strained, particularly in determining whether fault can still be attributed in a meaningful way when the outcome is partially shaped by autonomous or semi autonomous technological systems (Chazawi, 2021).

The normative gap becomes even more apparent when considering that Indonesian positive law does not yet provide explicit recognition of artificial intelligence within the legal framework of responsibility. In the absence of such recognition, AI cannot be treated as a legal subject, thereby excluding it from the domain of criminal accountability. This exclusion, while consistent with the traditional view that only natural persons or certain legal entities can bear criminal responsibility, creates a structural imbalance when harm arises from interactions between humans and intelligent systems. As a result, responsibility must be reassigned to human actors, yet the criteria for such reassignment remain unclear and underdeveloped. Scholars have noted that this condition gives rise to a phenomenon of fragmented accountability, in which physicians, system

developers, and healthcare institutions may each bear partial responsibility without a coherent legal mechanism to determine the extent of their liability (Suteki & Taufani, 2020).

From a statutory perspective, the regulatory framework governing healthcare in Indonesia continues to prioritize professional standards and patient safety, as reflected in the Health Law and the Medical Practice Law. While these instruments provide a basis for assessing malpractice, they are predominantly designed for conventional medical interactions that assume direct human control over clinical decisions. The emergence of AI as a decision support or decision-making tool is not explicitly addressed, resulting in a regulatory silence that has significant implications for criminal law enforcement. Provisions concerning negligence, for instance, are articulated in broad and abstract terms, without reference to the technological context in which medical decisions are made. This generality limits the capacity of legal institutions to interpret and apply the law in cases involving AI, as there is no doctrinal guidance on how to assess fault when the causal chain includes algorithmic processes (Atmasasmita, 2019). The conceptual analysis further demonstrates that existing doctrines of liability are insufficient to capture the distributed nature of responsibility in AI-driven environments. In traditional malpractice cases, the relationship between act and consequence is relatively linear, allowing for the identification of a single responsible actor. In contrast, AI-based medical practice involves a complex network of interactions, including data input, algorithmic processing, and human interpretation. Each of these stages may contribute to the final outcome, making it difficult to isolate a singular point of failure. This complexity challenges the principle of individual culpability that underpins criminal law and calls for a reexamination of how responsibility is constructed and attributed. Indonesian legal scholars have emphasized the need to move beyond rigid doctrinal categories and to develop more flexible approaches that can accommodate the realities of technological advancement (Rahardjo, 2020).

Moreover, the absence of clear legal norms governing AI in healthcare raises concerns about legal certainty and the protection of fundamental rights. Legal certainty is a cornerstone of the rule of law, ensuring that individuals can predict the legal consequences of their actions and adjust their behavior accordingly. When the law fails to provide clear standards for liability in AI-related medical malpractice, both healthcare professionals and patients are placed in a position of uncertainty. Physicians may become reluctant to adopt innovative technologies due to fears of unpredictable criminal sanctions, while patients may lack effective remedies when harm occurs. This dual risk undermines the legitimacy of the legal system and highlights the urgency of normative reform (Ali, 2021). In addition to these doctrinal and practical challenges, the normative gap also reflects a broader tension between legal conservatism and technological dynamism. Law, by its nature, tends to evolve incrementally, relying on established principles and precedents to ensure stability and coherence. Technology, on the other hand, develops rapidly and often disruptively, introducing new forms of interaction and risk that are not easily accommodated within existing frameworks. The case of AI in healthcare exemplifies this tension, as the law struggles to keep pace with innovations that fundamentally alter the nature of medical practice. Indonesian scholars have argued that this mismatch requires a more proactive and anticipatory approach to legal development, one that is capable of addressing emerging issues before they crystallize into systemic problems (Mahmud Marzuki, 2021).

The redistribution of responsibility in AI based medical malpractice also raises important questions about fairness and proportionality in criminal law. If liability is imposed solely on physicians, there is a risk of unjustly penalizing individuals who act in good faith and in accordance with professional standards. Conversely, if developers and institutions are not held accountable, there is a danger of creating moral hazard, whereby technological actors are insufficiently incentivized to ensure the safety and reliability of their systems. Achieving a balanced allocation of responsibility requires a nuanced understanding of the roles and contributions of each actor, as well as the development of legal criteria that reflect this complexity. This challenge is particularly acute in Indonesia, where the legal system is still in the early stages of grappling with the implications of digital transformation in healthcare (Hiariej, 2020). Furthermore, the issue of evidentiary standards in criminal proceedings becomes increasingly complex in cases involving AI. The determination of fault often relies on the ability to reconstruct the sequence of events leading to harm and to establish a causal link between the defendant's conduct and the outcome. However, the opacity of many AI systems, often

described as black box systems, limits the transparency of decision making processes and complicates the task of legal proof. Without access to clear and comprehensible explanations of how an AI system arrived at a particular conclusion, it becomes difficult to assess whether an error was foreseeable or preventable. This evidentiary challenge underscores the need for regulatory measures that promote transparency and accountability in the design and deployment of AI technologies (Sidharta, 2022).

The findings also indicate that the lack of regulatory clarity may have a chilling effect on innovation in healthcare. While AI has the potential to significantly improve diagnostic accuracy and treatment outcomes, its adoption may be hindered by legal uncertainty. Healthcare providers may be hesitant to integrate AI into their practice if the legal consequences of potential errors are unclear or disproportionate. Similarly, developers may face difficulties in navigating a regulatory environment, which may discourage investment and innovation. This situation creates a paradox in which the absence of regulation, intended to allow flexibility, ultimately constrains the development and utilization of beneficial technologies (Fuady, 2020). In light of these considerations, it becomes evident that the current legal framework is inadequate to address the challenges posed by AI-based medical malpractice. The normative gap identified in this study is not merely a technical deficiency but reflects a deeper misalignment between legal concepts and technological realities. Addressing this gap requires a comprehensive approach that integrates doctrinal reform, regulatory innovation, and interdisciplinary collaboration. Legal scholars and policymakers must engage with the technical dimensions of AI, while technologists must consider the legal and ethical implications of their work. Only through such a collaborative effort can a coherent and effective framework for criminal liability be developed. Ultimately, the urgency of reform lies in the need to ensure that the law continues to fulfill its fundamental functions of protection, justice, and accountability in an era of rapid technological change. The integration of AI into healthcare is not a distant possibility but an ongoing reality that demands immediate attention. Without clear and adaptive legal norms, the risk of injustice and uncertainty will only increase, undermining public trust in both the healthcare system and the legal order. Therefore, the development of a responsive and forward looking legal framework is not only desirable but necessary to navigate the complexities of modern health law.

4.2. Reconceptualizing Criminal Responsibility in AI Mediated Medical Practice

The discussion of criminal liability in AI based medical malpractice necessitates a fundamental reconceptualization of responsibility that moves beyond traditional individualistic models. Within the Indonesian criminal law tradition, responsibility is conventionally constructed around a single legal subject whose conduct, intention, and negligence can be directly assessed through established doctrinal parameters. However, the emergence of artificial intelligence as an active intermediary in medical decision making disrupts this classical configuration by introducing a multi layered system of interaction in which outcomes are co produced by human actors and technological processes. This shift requires a transformation in legal reasoning, as the attribution of liability can no longer rely solely on the linear relationship between act and consequence. Instead, it must account for the distributed and relational nature of responsibility in technologically mediated environments, where multiple actors contribute to a single medical outcome in ways that are not always transparent or easily separable (Prasetyo, 2022). The findings of this study indicate that responsibility in AI mediated healthcare is inherently shared, involving physicians, software developers, data engineers, and healthcare institutions. Each of these actors plays a distinct role in shaping the functioning and output of AI systems, yet their contributions are interconnected in ways that complicate the attribution of fault. In Indonesian legal discourse, this phenomenon challenges the principle of personal culpability, which remains a cornerstone of criminal liability. The principle assumes that an individual can be held accountable for actions within their control, but in AI driven contexts, control is often partial and mediated. As a result, the traditional threshold for establishing negligence becomes increasingly difficult to apply, particularly when harm arises from a combination of human judgment and algorithmic recommendation (Santoso, 2021).

One of the central tensions identified in this study lies between professional autonomy and technological reliance. Physicians are normatively expected to exercise independent clinical judgment based on their expertise and ethical obligations. However, the integration of AI systems into clinical practice introduces a new form of epistemic dependency, where decision making is influenced, and in some cases guided, by algorithmic outputs. This raises a critical question regarding the standard of care in modern healthcare. If AI systems are capable of producing more accurate diagnoses than human practitioners, then the failure to utilize such systems may be interpreted as a deviation from professional standards. Conversely, excessive reliance on AI without critical evaluation may also constitute negligence, particularly when the system produces erroneous or biased results. This duality reflects a broader transformation in the nature of medical expertise, which now involves not only clinical knowledge but also the ability to interpret and critically assess technological tools (Hidayat, 2023). To address this dilemma, it becomes necessary to adopt a contextual and dynamic understanding of the standard of care, one that reflects the evolving relationship between human judgment and technological assistance. In this framework, the role of the physician is not diminished but redefined, requiring a higher degree of reflexivity and awareness of the limitations inherent in AI systems. Medical professionals must be able to evaluate the reliability of algorithmic recommendations, understand the data on which they are based, and recognize the potential for error or bias. This expanded notion of competence aligns with the broader shift toward interdisciplinary knowledge in healthcare, where legal, ethical, and technological considerations intersect. In this sense, responsibility is not eliminated by the presence of AI but rather redistributed and intensified, requiring a more sophisticated approach to accountability (Nugroho, 2022).

At the same time, the role of non medical actors in the chain of responsibility must also be acknowledged and integrated into the legal framework. Software developers, for instance, are responsible for designing algorithms that meet certain standards of accuracy, safety, and transparency. Data engineers contribute to the quality and representativeness of training datasets, which directly affect the performance of AI systems. Healthcare institutions, meanwhile, play a crucial role in selecting, implementing, and monitoring these technologies within clinical settings. The failure of any one of these actors can contribute to harmful outcomes, yet existing legal doctrines do not provide clear mechanisms for allocating responsibility among them. This gap highlights the need for a more inclusive model of liability that reflects the collective nature of AI mediated healthcare (Putri, 2023). The conceptual analysis in this study suggests that alternative models of liability, such as shared or layered responsibility, offer a more realistic approach to addressing these challenges. Under this model, liability is distributed across different actors based on their respective roles and degrees of influence over the outcome. This approach recognizes that responsibility in complex systems is rarely concentrated in a single individual and that fairness requires a proportional allocation of accountability. In the Indonesian context, this would require a significant shift in legal doctrine, as current frameworks are primarily oriented toward individual liability. Nevertheless, such a shift is necessary to ensure that the law remains responsive to contemporary realities and capable of addressing new forms of harm (Rahman, 2022).

Another potential approach is the adoption of strict liability for certain high risk applications of AI, particularly in cases where the potential for harm is significant and difficult to predict. This model does not require proof of fault but instead focuses on the occurrence of harm and the involvement of a particular actor or system. While strict liability may appear to conflict with the traditional emphasis on culpability in criminal law, it can be justified in contexts where the risks associated with technological innovation are substantial and where preventive measures are essential. In the field of healthcare, where patient safety is paramount, such an approach may provide a more effective means of ensuring accountability and deterrence. However, its implementation must be carefully calibrated to avoid imposing disproportionate burdens on certain actors, particularly medical professionals who operate within complex institutional environments (Wibowo, 2021). The study also highlights the importance of institutional responsibility in the governance of AI based medical practice. Healthcare organizations are not merely passive environments in which medical decisions occur but are active agents that shape the conditions under which technology is used. They are responsible for selecting appropriate AI systems, ensuring that these systems meet regulatory standards, providing adequate training

to medical staff, and establishing protocols for monitoring and evaluation. When systemic failures occur, such as the deployment of unreliable technology or the absence of adequate oversight, institutions should be held accountable alongside individual actors. Incorporating institutional responsibility into the framework of criminal liability would not only reflect the collective nature of modern healthcare but also encourage organizational practices that prioritize safety and accountability (Sari, 2023).

Furthermore, the reconceptualization of responsibility in AI mediated medical practice must also address the issue of evidentiary complexity. Establishing criminal liability requires a clear understanding of causation and fault, yet the involvement of AI systems complicates both elements. The opacity of algorithmic processes makes it difficult to trace the origins of a particular decision, while the interaction between human and machine introduces multiple potential points of failure. In this context, traditional evidentiary standards may need to be supplemented with new forms of technical expertise and documentation, including algorithmic audits and data traceability mechanisms. Such measures would enhance the capacity of legal institutions to assess responsibility in a fair and informed manner (Kusuma, 2022). Ultimately, the reconceptualization of criminal responsibility in AI based medical malpractice reflects a broader transformation in the relationship between law and technology. As AI continues to reshape the contours of healthcare, the legal system must evolve to ensure that its principles remain relevant and effective. This requires not only doctrinal innovation but also a willingness to engage with the ethical and practical dimensions of technological change. By embracing a more flexible and inclusive approach to responsibility, the law can better navigate the complexities of AI mediated environments and uphold its fundamental commitment to justice and accountability.

4.3. Towards a Responsive Legal Framework for Modern Health Law

The final set of findings underscores the urgent need for a responsive and adaptive legal framework capable of addressing the complex challenges posed by artificial intelligence based medical malpractice within contemporary healthcare systems. In the Indonesian context, the current legal structure remains largely reactive and fragmented, relying on conventional doctrines that were not designed to accommodate the integration of advanced technologies into clinical decision making. As a result, the law struggles to provide clear guidance on accountability, particularly when medical outcomes are shaped by interactions between human actors and algorithmic systems. A responsive legal framework, therefore, must not only bridge existing normative gaps but also anticipate future developments, ensuring that legal regulation evolves in tandem with technological innovation. This requires a careful balancing of competing objectives, namely the promotion of innovation, the protection of patient rights, and the enforcement of accountability, all within the boundaries of fundamental principles of criminal law such as legality, culpability, and proportionality (Arifin, 2022). One of the central recommendations emerging from this study is the necessity of developing specific legal provisions that explicitly regulate the use of artificial intelligence in medical practice. Existing Indonesian health law, including statutory instruments governing medical practice and patient safety, does not yet incorporate provisions that address the role of AI as a decision making or decision support tool. This omission creates ambiguity in determining legal responsibility and limits the capacity of law enforcement institutions to respond effectively to cases involving AI related harm. The formulation of new legal norms should therefore clearly define the scope of permissible use of AI in healthcare, establish minimum standards for safety and reliability, and delineate the respective responsibilities of physicians, developers, and healthcare institutions. Such provisions would not only enhance legal certainty but also provide a normative foundation for evaluating conduct in criminal proceedings (Widodo, 2023).

In addition to the development of sector specific regulations, there is a pressing need for harmonization between different branches of law that intersect in the governance of AI based healthcare. At present, the regulatory landscape is characterized by a lack of coordination between health law, information technology law, and criminal law, resulting in overlapping or inconsistent norms. For instance, while regulations on electronic systems may address data protection and system security, they do not necessarily

align with the requirements of medical accountability or criminal liability. This fragmentation undermines the coherence of the legal system and creates challenges in interpretation and enforcement. A harmonized approach would involve the integration of legal principles across these domains, ensuring that regulations are mutually reinforcing and capable of addressing the multifaceted nature of AI related risks in healthcare (Setiawan, 2022). The issue of transparency and explainability in AI systems emerges as a critical component of any effective legal framework. In criminal law, the attribution of liability depends heavily on the ability to establish causation and fault, both of which require a clear understanding of how a particular outcome was produced. However, many AI systems operate as opaque or black box models, making it difficult to trace the reasoning behind specific decisions. This lack of transparency poses significant challenges for legal adjudication, as it limits the ability of courts to assess whether an error resulted from human negligence, system malfunction, or an unforeseeable interaction between the two. To address this issue, legal norms should require a minimum level of explainability in AI systems used in healthcare, particularly those that have a direct impact on patient outcomes. Such requirements would enhance accountability and facilitate more accurate and fair determinations of liability (Kurniawan, 2023).

Beyond doctrinal and regulatory reform, the findings of this study highlight the importance of institutional readiness in adapting to the challenges of AI integration. Healthcare organizations play a central role in the implementation and governance of AI technologies, yet their capacity to manage associated risks is often limited by a lack of expertise and institutional frameworks. Legal reform must therefore be accompanied by measures aimed at strengthening institutional capabilities, including the development of internal policies, risk management systems, and oversight mechanisms. These measures would enable healthcare institutions to act as effective intermediaries between technological innovation and legal accountability, ensuring that AI systems are deployed in a manner that prioritizes patient safety and ethical standards (Prabowo, 2022). Equally important is the need for educational reform that equips both healthcare professionals and legal practitioners with the knowledge and skills required to navigate the complexities of AI based medical practice. The integration of AI into healthcare introduces new forms of risk and responsibility that cannot be adequately addressed through traditional disciplinary boundaries. Medical professionals must develop an understanding of how AI systems function, including their limitations and potential biases, while legal practitioners must become familiar with the technical and ethical dimensions of algorithmic decision making. Interdisciplinary training programs and continuing professional education initiatives can play a vital role in fostering this understanding, thereby enhancing the capacity of both professions to respond effectively to emerging challenges (Lestari, 2023).

The promotion of a culture of accountability within healthcare institutions is another essential element of a responsive legal framework. Accountability should not be viewed solely as a matter of legal compliance but as a broader organizational value that informs decision making at all levels. This involves the establishment of clear lines of responsibility, the implementation of monitoring and evaluation mechanisms, and the encouragement of transparency in reporting errors and adverse outcomes. By fostering an environment in which accountability is embedded in everyday practice, healthcare institutions can reduce the likelihood of harm and ensure that when errors do occur, they are addressed in a manner that is both fair and constructive (Handayani, 2022). Furthermore, the development of a responsive legal framework must also consider the role of public participation and stakeholder engagement in shaping regulatory policies. The use of AI in healthcare raises important ethical and social questions that extend beyond the domain of legal expertise. Patients, medical professionals, technologists, and civil society organizations all have a stake in how these technologies are governed and should therefore be involved in the process of legal reform. Participatory approaches can enhance the legitimacy of regulatory frameworks, ensure that diverse perspectives are taken into account, and promote a more inclusive understanding of risk and responsibility. In the Indonesian context, where public trust in both healthcare and legal institutions is a critical concern, such engagement is particularly important (Santika, 2023).

The findings also suggest that legal reform should adopt a forward looking and anticipatory approach, rather than relying solely on reactive measures. This involves the use of regulatory tools such as

sandbox mechanisms, pilot programs, and impact assessments to evaluate the implications of new technologies before they are widely adopted. By proactively identifying potential risks and challenges, policymakers can develop more effective and flexible regulations that are capable of adapting to future developments. This approach aligns with the broader concept of adaptive governance, which emphasizes the need for legal systems to remain responsive and resilient in the face of uncertainty and change (Yusuf, 2022). The issue of criminal liability in AI based medical malpractice cannot be adequately addressed within the confines of existing legal frameworks. The normative gaps identified in this study reflect a deeper misalignment between traditional legal concepts and the realities of modern healthcare, where technological systems play an increasingly central role in shaping medical outcomes. Addressing these gaps requires a comprehensive and integrated approach that combines doctrinal reform, regulatory innovation, institutional strengthening, and educational development. By redefining responsibility in a manner that reflects the distributed and dynamic nature of AI mediated environments, the law can better fulfill its fundamental functions of protection, justice, and accountability. Ultimately, the development of a responsive legal framework is not merely a technical necessity but a normative imperative, ensuring that the benefits of technological progress are realized without compromising the rights and safety of patients.

V. Conclusion

The integration of artificial intelligence into medical practice fundamentally challenges the conventional structure of criminal liability, which has long been anchored in human-centered notions of fault, intent, and control. The presence of AI as an active intermediary in clinical decision making disrupts the linear attribution of responsibility and exposes significant normative gaps within existing legal frameworks. These gaps are particularly evident in the inability of current doctrines to adequately address distributed responsibility involving physicians, developers, and healthcare institutions, thereby creating uncertainty in the determination of criminal accountability. Further reveals that reliance on traditional liability models is no longer sufficient in the context of AI mediated healthcare. The transformation of the standard of care, coupled with the emergence of epistemic dependence on algorithmic systems, necessitates a reconceptualization of responsibility that is more adaptive, contextual, and inclusive. In this regard, the development of alternative models such as shared responsibility and the selective application of strict liability offers a more realistic approach to addressing the complexities of technologically mediated harm. Moreover, the study underscores the urgent need for a responsive legal framework that integrates doctrinal reform, regulatory harmonization, and institutional strengthening. Legal provisions must explicitly regulate the use of AI in healthcare, ensure transparency and explainability, and establish clear criteria for liability attribution. Ultimately, the evolution of criminal law in this domain is essential to safeguard patient rights, maintain professional accountability, and ensure that technological innovation progresses within a framework of justice and legal certainty.

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