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Article

Causation in AI Tort Litigation: Legal Dilemmas of Algorithmic Black Boxes and Burden of Proof Allocation

Jinbo Ma *

Gannan Normal University, Ganzhou 341000, China.

*Corresponding author: Jinbo Ma, 3309992199@qq.com.

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Abstract: Through a comparative legal analysis of different jurisdictions, this study explores the difficulties algorithmic black boxes bring to traditional causation and the allocation of the burden of proof in artificial intelligence tort claims. The study employs a cross-jurisdictional doctrinal analysis and a methodical case study methodology to examine important AI tort cases related to algorithmic decision-making platforms, medical AI systems, and autonomous vehicles. Because courts cannot determine causal relationships using traditional evidentiary frameworks, the results show that traditional "but-for" tests of causation are intrinsically limited when applied to black box machine learning systems. Systemic differences in burden allocation mechanisms are revealed by cross-jurisdictional canvassing, with different jurisdictions implementing a range of strategies, from mandates for algorithmic audits and presumptive liability frameworks to stricter requirements for expert testimony. According to the research, there are significant informational gaps between plaintiffs and AI system controllers, which calls for creative legal solutions like updated collective liability and causation presumptions. The results show that, while maintaining core tort law principles, legal frameworks must be modified to allow probabilistic algorithmic decision-making. Advocating for the shift to technologically adaptive liability regimes that strike a balance between victim protection and innovation incentives is also necessary. It is suggested that the aforementioned be put into effect through increased judicial technical proficiency and standardized transparency requirements.

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1. Introduction

Use of artificial intelligence systems in industries has effectively challenged traditional tort law principles, introducing unexpected difficulties in causation and the allocation of burden of proof in civil cases. Healthcare examples demonstrate the potential for AI systems to surpass humans while making it difficult to determine liability, reflecting overall challenges to legal systems (Banja et al., 2022). Healthcare technology applications recognize intrinsic tensions between technological advancement and legal accountability when AI systems serve as intermediaries of conclusions and outcomes (Bottomley & Thaldar, 2023). The essential challenge arises where conventional burden of proof standards intersects algorithmic opacity, and the legal system must offer a safety net to victims while adapting to technical complexity (Dacoronia, 2023). Contemporary tort litigation is faced with multi-dimensional challenges since AI systems operate on algorithmic processes that are resistant to traditional causal analysis (Dheu & De Bruyne, 2023).

The black box of algorithms is not just a technical challenge but an epistemological challenge to legal reasoning itself. AI technologies increasingly make autonomous decisions with effects on human welfare, but their decision-making processes are transparently opaque to legal scrutiny (Fraser et al., 2022). Legal scholarship has already begun to address these challenges in the forms of rebuttable presumptions of causality and enhanced evidence disclosure for algorithmic defects (Goicovici, 2023). Explainable AI solutions present possible remedies; however, their implementation within legal frameworks remains theoretically insufficiently developed (Herrera, 2025). Current liability frameworks are insufficient for addressing causation issues related to AI, especially regarding the distribution of the burden of proof across jurisdictions (Llorca et al., 2023). Administrative solutions continue to evolve in response to AI-induced risks, safeguarding incentives for innovation (Rao, 2023). General frameworks for algorithmic accountability are still broken and need to be built in a systematic way (Rico, 2024). The civilian law

requirement for transparency inherently contradicts algorithmic inscrutability, thereby imposing structural disadvantages on tort plaintiffs (Tschider, 2021). The issue of secrecy seems to be most problematic at the intersection of traditional causation tests and AI systems whose decision-making processes are not entirely explicable (Wojtczak & Księżak, 2021).

By developing a thorough analytical framework to examine how algorithmic black boxes undermine conventional causation analysis and burden of proof allocation in tort actions, this study takes novel steps to align technological demands with fundamental legal principles.

2. Data and Methods

2.1. Research Methodology and Legal Framework Analysis

The study addresses the complex relationship between AI technology and tort liability using a multifaceted approach that includes a systematic literature review, case study, and comparative legal analysis. In order to investigate how various legal regimes address the problem of algorithmic obscurity in civil proceedings, the study procedure mimics traditional comparative law methodologies (Fraser et al., 2022).

The comparative law perspective takes into account jurisdictional differences and how legislatures and courts have adjusted current tort paradigms to meet the demands of technological complexity when addressing concerns about causality brought about by AI in common and civil law systems. The technique enables the identification of patterns and varying strategies in the legal reactions to the problems pertaining to AI liability.

Systematic literature review methodology incorporates legal scholarship alongside interdisciplinary scholarship spanning computer science, ethics, and regulation studies. The section on theoretical analysis brings together existing doctrinal approaches with emerging AI governance precepts to identify gaps in the current legal knowledge.

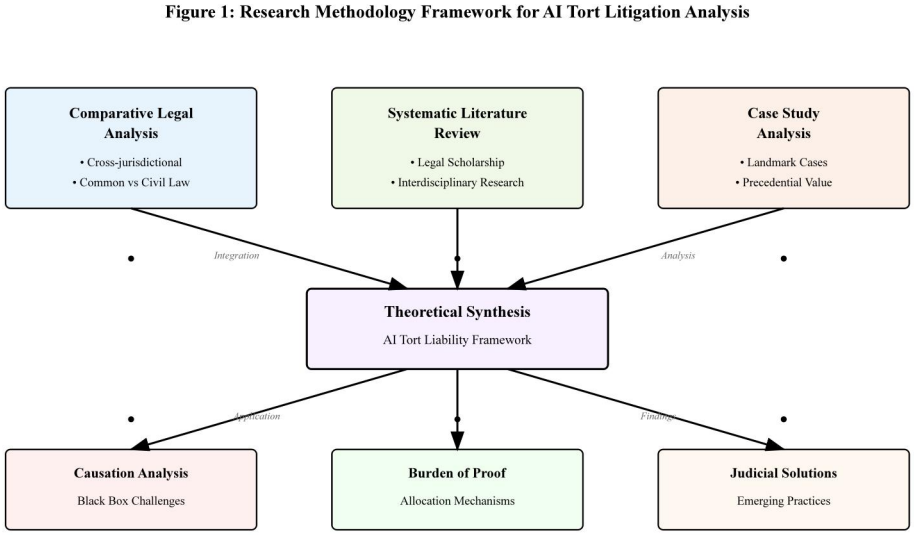
Case study research follows purposive sampling in the selection of landmark AI tort case law judgments demonstrating evolutionary improvement in the examination of causation and the burden of proof allocation (Llorca et al., 2023). The case

selection criteria prefer cases that demonstrate novel judicial thinking, establishing precedent, or being significant departures from traditional tort approaches.

The analytical framework integrating these methodological components is outlined in the research design, as illustrated in **Figure 1**, which demonstrates the logical progression from comparative analysis through theoretical synthesis to empirical case study, ultimately generating detailed insights into AI tort litigation problems.

Figure 1

Analytical Framework for AI Tort Litigation Causation and Burden of Proof Assessment



2.2. Case Selection and Analytical Approach

This research applies systematic case selection and cross-jurisdictional comparison specifically designed to address the challenges in AI tort litigation. The selection of the landmark AI tort cases aims to prioritize those best demonstrating excellent judicial consideration of algorithmic causation, greatest precedential influence for deciding liability structures, and most clear deviations from traditional approaches in addressing technological opacity issues (Fraser et al., 2022). Health care and self-driving car cases because of their representative status in presenting challenges related to causation determination, AI systems, algorithmic

decision-making platforms, and intelligent recommendation systems comprise the primary analytical scope.

A comprehensive examination of the common law and civil law traditions' treatment in courts is part of the cross-jurisdictional comparative methodology, which pays particular attention to how different legal systems alter standard causation tests to take algorithmic black box scenarios into account. When courts apply traditional evidence standards that are insufficient for evaluating harm caused by AI, the comparative framework enables the identification of new trends, alternative solutions, and innovative legal reasoning techniques.

Statutory provisions, court rulings, and new regulatory standards addressing algorithmic accountability and transparency requirements are all systematically studied as part of the methodological process for legal documents and regulatory standards. The procedure combines empirical court trend-setting monitoring with doctrinal analytical frameworks to provide a comprehensive understanding of how legal frameworks change to meet emerging technological challenges in establishing tort liability (Llorca et al., 2023).

3. Results

3.1. Algorithmic Opacity and Traditional Causation Tests

The fundamental conflict between the opacity of algorithms and the outdated methods of determining causation is the main problem with modern tort actions. When applied to artificial intelligence systems whose operations are inherently opaque, drained "but-for" tests of causation which presume plaintiffs in order to determine harm would not have occurred but for the defendant's behavior face new difficulties. Because machine learning algorithms, and deep learning models in particular, operate through complex mathematical mappings that are difficult to comprehend, there are epistemic barriers to recognizing causality.

The conventional causal chain model, which draws a straight line from defendant action to plaintiff injury, is vulnerable to systematic disruption in AI contexts. In contrast to the usual tort case, where human decision-making can be reconstructed using evidence and testimony, algorithmic decision-making occurs inside computational black boxes that are impervious to judicial scrutiny. This opacity

problem goes beyond technical difficulty to the level of an epistemological challenge, probing the most profound facets of legal reasoning.

The gap between legal causation tests and contemporary technology seems to be the largest when it comes to emergent behavior machine learning technologies that are challenging to interpret from original programming.

3.2. Burden of Proof Distribution in AI Tort Cases

Implementing the traditional burden of proof allocation dogma in artificial intelligence (AI) and tort cases, where computational intractability creates widespread informational asymmetries between parties, is fraught with difficulties. Traditional formulations of establishing causation by a preponderance of the evidence are frustrated when algorithmic decision-making processes are technologically impervious to independent examination. Because they lack access to the proprietary algorithmic information needed to establish causal relationships, resentful parties are effectively left with an impossible burden of proof due to this technical anonymity.

Insofar as they would help plaintiffs with their disabilities, burden-shifting tools are also materially disabled under AI. Because established indicators like product defect or res ipsa loquitur applicability must be redesigned to change the requirements of algorithmic systems, courts find it difficult to determine the proper trigger points for burden reversal. Different burden allocation models result from cross-jurisdictional comparison. The various legal systems use common mechanisms to deal with algorithmic opacity problems, as **Table 1** illustrates.

Table 1

Comparative Analysis of Burden of Proof Allocation Mechanisms in AI Tort Cases

Jurisdiction	Traditional Standard	AI Case Adaptation	Burden Reversal Conditions	Balancing Mechanism
United States	Preponderance of Evidence	Enhanced Expert Testimony	Product Defect Presumption	Technical Discovery Process
European Union	Strict Proof Standard	Algorithm Audit Requirements	Harm Presumption Rules	GDPR Transparency Rights
United Kingdom	Balance of Probabilities	Reasonable Inference Principle	Information Asymmetry Cases	Judicial Case Management
Germany	Full Proof Standard	Technical Expert Participation	Organizational Fault Presumption	Proportionality Principle

Tort claimants are at a systemic disadvantage due to the asymmetrical relationship between algorithmic complexity and victim proofing ability. Individual litigants in low-probability cases frequently lack the technical know-how and resources necessary to challenge using sophisticated machine learning system expert witnesses or full algorithmic audits. The fundamental ideas of fairness in civil procedure are distorted by this asymmetry, which calls for creative approaches to burden distribution that strike a balance between technological demands and the preservation of access to justice.

3.3. Information Asymmetry and Evidence Access

Evidence in AI torts is facing significant obstacles due to the conflict between the need for court transparency and the protection of commercial trade secrets. Tech companies use intellectual property rights as a shield to keep the algorithms from being made public, vehemently opposing the courts' demands for detailed technical information to establish causation and liability.

The objectivity of algorithmic auditing procedures as fact-finding tools is called into question by the oppressive institutional barriers they encounter. Although there are no formal procedures for conducting independent algorithmic audits, the law grants firm's discretion over the scope and methodology of audits.

Expert paradigms are challenged in one way by cutting-edge machine learning technology. Expertise paradigms are difficult to modify to explain algorithmic complexity in a way that nontechnical jurors and judges can comprehend, and the dearth of qualified experts is a key piece of evidence.

Explainable AI, theoretically tasked with solving transparency issues, has been deeply troubled by implementation within the juridical model. Technical XAI promise and legal understandability languish mostly in between, outside of potential judicial implementation.

3.4. Judicial Innovation and Legal Framework Adaptation

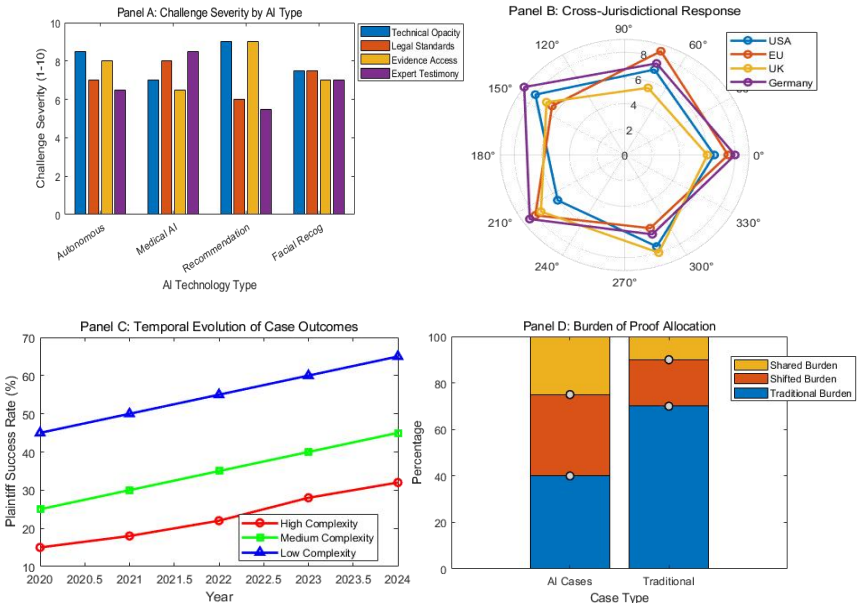
Courts of jurisdiction have been ready to deal with AI causation issues through adaptable legal reasoning and empowering technical assessing tools. Without being constrained by antiquated tort law maxims, court responses exhibit responsive strategies that are resilient to algorithmic complexity. Modified tests of causation

using probabilistic logic, increased reliance on technical experts, and innovative burden distribution that takes into account the informational asymmetries of AI claims are some examples of these modifications.

In order to combat algorithmic opaqueness, presumptions of causation rules have been developed. In cases where defendants retain substantial technical knowledge, courts have created rebuttable presumptions that shift the burden of proof. The multi-dimensional model, which is shown in **Figure 2**, shows significant judicial variation across challenge types for the dynamics of technical complexity, legal standards, and jurisdictional styles that decide cases.

Figure 2

Multi-Dimensional Analysis of AI Causation Challenges in Tort Litigation



Technical evaluative specialist mechanisms that balance algorithmic complexity and evidence comprehension are characteristics of new court practice. Different approaches to expert testimony, evidence requirements, and liability determination are demonstrated by a cross-jurisdictional comparison of high-profile cases, as shown in **Table 2**, with a gradual shift towards increasingly complex models in response to issues with AI-related causation.

Table 2

Judicial Approaches to AI Tort Litigation: A Cross-Jurisdictional Analysis

Landmark Case	Jurisdiction	Causation Method	Evidence Standard	Expert Witness	Key Holdings

Uber Autonomous Vehicle Case	US Federal Court	Technical Causation Reconstruction	Clear and Convincing	Algorithm Engineers	Algorithmic Defect Recognition
Tesla Autopilot Case	California State Court	Product Liability Theory	Preponderance of Evidence	Vehicle Safety Experts	Design Defect Presumption
Medical AI Misdiagnosis Case	UK High Court	Professional Negligence Standard	Balance of Probabilities	Medical AI Specialists	Duty of Care Extension
Algorithm Discrimination Case	German Federal Court	Indirect Causation	Strict Proof Standard	Statistical Experts	Algorithmic Transparency Obligation
Smart Recommendation Case	European Court	Rights Balancing Principle	GDPR Standard	Data Scientists	Algorithmic Accountability

4. Discussion

4.1. Theoretical Implications and Legal Doctrine Evolution

AI technologies necessitate a fundamental rethinking of long-standing tort law doctrines, which both require the explicit articulation of causality and implicit assumptions about human agency. Courts must find ways to balance technological sophistication against existing legal reasoning because the theoretical account of algorithmic enablement of harm production must be in terms of probabilistic rather than deterministic models of causation.

Traditional “but-for” tests of causation will need to change in order to account for probabilistic attribution forms of harm and statistical correlation analysis. This entails creating hybrid approaches that address multi-variable algorithmic decision-making processes by fusing computational model tools with conventional proximate cause analysis.

4.2. Practical Challenges and Policy Recommendations

The development of judicial technical competence is the most important component of successful AI tort litigation, with efficient training programs balancing

algorithmic expertise with legal reasonableness. The establishment of a legal standard algorithmic audit process protocol would improve the operational efficiency of the systematic evidence evaluation framework while maintaining procedural uniformity across jurisdictions. Incentives for technology development will have to be balanced with protecting businesses from harm through dynamic regulation strategies that don't impede desirable AI innovation and offer long-term liability regimes.

5. Conclusion

This study demonstrates how algorithmic black boxes inevitably complicate and reverse conventional tort law causation determination and evidence allocation, posing new legal issues that call for a methodical reconfiguration of doctrine. The study finds that early judicial innovations are holding out for gradual advancement towards technologically advanced systems of justice, resulting in significant cross-jurisdictional disparities in addressing AI-generated causation issues. Reconfiguring current tort paradigms, such as probabilistic accounts of causation and models of liability under joint liability, that may be adjusted potentially for informational asymmetry of AI systems is the essence of algorithmic transparency.

The article identifies key areas where technical reality and current legal regulations clash, and it makes recommendations for standardized algorithms for algorithmic auditing as well as mandatory judicial technical competency levels. Future studies will be necessary to provide a thorough examination of novel AI regimes of liability for a variety of technological applications and to refute empirical testing of proposed burden-shifting models. The design of the legal framework strikes a balance between victim protection and innovation incentives through dynamic regulation that imposes a threshold of transparency obligations without discouraging technological innovation. One paradigm shifts in tort law that is ready for continued scholarly attention and policy innovation is the push for algorithmic accountability.

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References

[1] Banja, J. D., Hollstein, R. D., & Bruno, M. A. (2022). When artificial intelligence models surpass physician performance: Medical malpractice liability in an era of advanced artificial intelligence. *Journal of the American College of Radiology, 19*(7), 816–820. https://doi.org/10.1016/j.jacr.2022.04.002

[2] Bottomley, D., & Thaldar, D. (2023). Liability for harm caused by AI in healthcare: An overview of the core legal concepts. *Frontiers in Pharmacology, 14*, 1297353. https://doi.org/10.3389/fphar.2023.1297353

[3] Dacoronia, E. (2023). Burden of proof: How to handle a possible need for facilitating the victim's burden of proof for AI damage? In S. Lohsse, R. Schulze, & D. Staudenmayer (Eds.), *Liability for AI: Münster Colloquia on EU Law and the Digital Economy VII* (pp. 201–214). Hart Publishing. https://doi.org/10.5771/9783748911842

[4] Dheu, O., & De Bruyne, J. (2023). Artificial intelligence and tort law: A multi-faceted reality. *European Review of Private Law, 31*(2/3), 271–298. https://doi.org/10.54648/ERPL2023014

[5] Fraser, H., Simcock, R., & Snoswell, A. J. (2022, June). AI opacity and explainability in tort litigation. In *Proceedings of the 2022 ACM Conference on Fairness, Accountability, and Transparency* (pp. 185–196). https://doi.org/10.1145/3531146.3533089

[6] Goicovici, J. (2023). Rebuttable presumptions of causality and reverberations of evidence disclosure, as epitomic pieces in the physiognomy of liability for defective AI. *Journal of Law, Market & Innovation, 2*(1), 28–54. https://heinonline.org/HOL/P?h=hein.journals/jlmin2&i=32

[7] Herrera, F. (2025). *Making sense of the unsensible: Reflection, survey, and challenges for XAI in large language models toward human-centered AI*. arXiv. https://arxiv.org/abs/2505.20305

[8] Llorca, D. F., Charisi, V., Hamon, R., Sánchez, I., & Gómez, E. (2023). Liability regimes in the age of AI: A use-case driven analysis of the burden of proof. *Journal of Artificial Intelligence Research, 76*, 613–644. https://doi.org/10.1613/jair.1.14181

[9] Rao, H. (2023). Ethical and legal considerations behind the prevalence of ChatGPT: Risks and regulations. *Frontiers in Computing and Intelligent Systems, 4*(1), 23–29. https://doi.org/10.54097/fcis.v4i1.11064

[10] Rico, P. (2024). *AI and data governance: A legal framework for algorithmic accountability and human rights*. Routledge.

[11] Tschider, C. A. (2021). Legal opacity: Artificial intelligence's sticky wicket. *Iowa Law Review Online, 106*, 126–136. https://ilr.law.uiowa.edu/print/volume-106-issue-1/legal-opacity-artificial-intelligences-sticky-wicket/

[12] Wojtczak, S., & Księżak, P. (2021). Causation in civil law and the problems of transparency in AI. *European Review of Private Law, 29*(4), 923–950. https://doi.org/10.54648/erpl2021042