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Reconstructing the Admissibility Standard for Neuroscientific Evidence Concerning Defendants in Indonesian Criminal Proceedings: A Functional Comparison with United States Federal Law

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ABSTRACT

Neuroscientific evidence concerning a defendant may assist in explaining neurological conditions, cognitive functions, and capacities relevant to criminal responsibility. Its use, however, raises issues concerning data sufficiency, methodological reliability, reliability of application to an individual, inferential limitations, mental privacy, and conformity with applicable legal categories. This study examines the adequacy of Indonesian law and reconstructs an admissibility standard for neuroscientific evidence concerning defendants in court proceedings through a functional comparison with United States federal law. This normative legal research is prescriptive in nature and employs statutory, conceptual, case, and comparative approaches. The findings demonstrate that Indonesian law regulates statutory means of evidence, expert testimony, authentication, the lawful acquisition of evidence, health information, personal data protection, examination by the parties, and the obligation to provide reasons in judgments. The existing provisions, however, do not integrate data sufficiency, methodological reliability, reliability of application, and inferential relationships as specific admissibility requirements. The reconstruction produces eleven elements of examination and eight procedural stages. A deficiency in a foundational requirement produces legal consequences when the law in force has expressly prescribed them. Exclusion based on scientific unreliability that has not been regulated requires legal reform. Residual weaknesses affect evidentiary weight. Implementing the standard requires regulation of authority, data governance, expert capacity, equal access, and empirical testing.

Keywords: *Admissibility of Evidence; Criminal Procedure Law; Defendant; Neuroscientific Evidence; Scientific Reliability.*

INTRODUCTION

Advances in neuroscience and neurotechnology have increased the capacity to obtain information concerning brain structure, neural activity, cognitive functions, and behavior. These developments have also supported the study of neurolaw, which examines the relationship between law and neuroscience and the implications of knowledge concerning the nervous system for the formulation and application of law (Aggarwal & Jain, 2024; Mishra, 2024; García-López et al., 2025). Neuroscientific evidence in this study is not limited to brain images. It encompasses data obtained from measurements of the nervous system, processed data, examination reports, and expert opinions that explain the relationship between scientific findings and legal propositions. Each component must be distinguished because authenticated data do not, by themselves, establish the reliability of the method, the reliability of its application, or the accuracy of the expert's interpretation (Reddy, 2025).

Neuroscientific evidence may be used to explain the defendant's mental condition at the time of the criminal offense, the effects of a disorder on particular functions, the need to impose a measure, or other circumstances relevant to the case. A neurological diagnosis, anatomical abnormality, or change in neural activity, however, does not directly establish the defendant's capacity for criminal responsibility. Findings derived from group-level studies also cannot be applied directly to an individual defendant. Their application must account for the study population, examination protocol, data quality,

individual circumstances, and purpose of the examination (Carrim, 2024; Christensen et al., 2024). Functional magnetic resonance imaging, hereinafter referred to as fMRI, for example, measures physiological changes as indirect indicators of neural activity. Its results must be analyzed together with the defendant's medical history, clinical examination, neuropsychological assessment, behavioral observations, performance validity, and relevant case information (Mallorquí-Ruscalleda, 2024; Marcopulos et al., 2024; Zhang et al., 2024; Zheng et al., 2024).

The collection and use of neural data also concern consent, bodily integrity, the confidentiality of health information, personal data protection, mental privacy, and cognitive liberty (Farahany, 2023; Mishra, 2024; García-López et al., 2025). The presentation of brain images may produce a persuasive effect that is disproportionate to their inferential strength. Biological explanations may also lead to the assumption that a defendant's behavior is determined exclusively by the condition of the brain. Evidence offered in mitigation may even be used to support an assessment of the risk of reoffending or limitations in behavioral control when the purpose and limits of its use have not been clearly defined (Khalid et al., 2024). Biological causation therefore cannot be equated with legal incapacity. Social and structural factors must also remain part of the assessment of behavior and criminal responsibility (Borbón, 2024; Díaz-Soto & Borbón, 2024; Sapolsky, 2024; Kadir et al., 2025; Morse, 2025).

Recent reforms of Indonesian criminal law provide substantive and procedural legal bases relevant to these issues. Article 38 and Article 39 of Law Number 1 of 2023, as amended by Law Number 1 of 2026, regulate mental or intellectual conditions and their consequences for criminal responsibility. Law Number 20 of 2025 regulates evidence, experts, technical assistance during investigation, electronic evidence, authentication, the lawful acquisition of evidence, and defendants' rights. Medical examinations, the confidentiality of medical records, and data processing are also governed by Law Number 27 of 2022, Law Number 17 of 2023, and Government Regulation Number 28 of 2024. Nevertheless, these provisions do not integrate data sufficiency, methodological reliability, reliability of application, and inferential relationships as specific requirements for admitting neuroscientific evidence. The availability of experts and facilities must also be assessed empirically within each judicial setting. Findings concerning particular conditions cannot be generalized as representing uniform circumstances throughout Indonesia (Fernando et al., 2025).

United States federal law serves as a comparator because the Federal Rules of Evidence (FRE) distinguish the functions of relevance, authentication, the basis of expert opinions, reliability, risk balancing, and the determination of preliminary questions. Rule 702, as amended in 2023, expressly addresses the burden borne by the party offering expert testimony, the sufficiency of facts or data, the reliability of

principles and methods, and the reliability of their application. Rule 107, which took effect in 2024, also distinguishes illustrative aids from evidence. This distinction is relevant to the use of brain images, diagrams, and other forms of visualization in court proceedings. The federal structure is supplemented by *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, *General Electric Co. v. Joiner*, *Kumho Tire Co. v. Carmichael*, and *United States v. Semrau* (Aggarwal & Jain, 2024; Kurtz & Pintarelli, 2024). The comparison in this study is limited to federal law. It is not intended to adopt foreign rules directly or to equate the institutional structures of the two legal systems.

Previous studies may be classified according to their respective areas of inquiry. Studies on neurolaw and neuroethics examine the protection of rights and the governance of neurotechnology. Studies on criminal responsibility analyze biological causation, free will, and capacity. Scientific studies examine the limitations of imaging, assessment, and individual inference. Indonesian legal scholarship has identified the potential benefits and constraints associated with the application of neuroscience (Aggarwal & Jain, 2024; Christensen et al., 2024; Mallorquí-Ruscalleda, 2024; Fernando et al., 2025; Reddy, 2025). These studies have not comprehensively analyzed recent Indonesian criminal law reforms, the classification of evidentiary components, a functional comparison with United States federal law, the normative status of each requirement, and an examination mechanism centered on defendants. The original contribution of this study is the reconstruction of a standard based on evidentiary components and scientific claims that distinguishes the law in force, strengthening through legal interpretation, and proposed legal reform.

This study examines the legal status and admissibility issues of neuroscientific evidence concerning defendants. It also reconstructs the elements of the standard and the procedural mechanism for their examination. The reconstruction is limited to judicial determinations concerning the admission of evidence during court proceedings. The formation and acquisition of evidence at earlier stages are analyzed only insofar as they affect authentication, lawful acquisition, data integrity, reliability, and the capacity to challenge the evidence at trial. Competence to stand trial, sentencing, and the need to impose a measure remain relevant contextual functions. These three matters do not replace the principal focus on the admissibility of neuroscientific evidence concerning defendants.

METHOD

This study constitutes normative legal research that is prescriptive in nature. It employs statutory, conceptual, case, and comparative approaches (Marzuki, 2017; Qamar & Rezah, 2020). The unit of analysis is not determined by the name of a technology or diagnosis. It is determined by evidentiary components, scientific claims,

legal propositions concerning the defendant, and the inferential relationships among them. The analysis focuses on the admission of evidence at trial. The investigation stage is examined only insofar as it concerns data provenance, the lawfulness of the examination, data integrity, and the parties' ability to challenge the evidence.

The statutory approach examines criminal responsibility, the formation and presentation of statutory means of evidence, defendants' rights, health regulation, and personal data protection. The conceptual approach distinguishes admissibility, relevance, authentication, reliability, validity, and evidentiary weight. The case approach identifies legal rules, judicial reasoning, the level of the deciding court, and the limits of precedent. The comparative approach is functional. It examines how Indonesian law and United States federal law regulate evidentiary issues that perform comparable functions without presuming identical institutional structures.

Indonesian primary legal materials comprise Law Number 48 of 2009, Law Number 27 of 2022, Law Number 1 of 2023, Law Number 17 of 2023, Law Number 20 of 2025, and Government Regulation Number 28 of 2024. Comparative legal materials comprise FRE; 18 U.S.C. § 17; and the decisions in *Daubert*, *Joiner*, *Kumho Tire*, and *Semrau*. § 4.01 of the Model Penal Code is used as a persuasive conceptual source ([Greenawalt et al., 2017](#)). It is neither federal law in force nor an admissibility standard.

Secondary legal materials comprise books, scholarly articles, and conceptual reports. Their selection was based on relevance, scholarly authority, currency, the traceability of their reasoning, and their capacity to support or limit a claim. Sources that do not directly examine neuroscientific evidence are used only by analogy. They are not used as a basis for asserting the reliability of a technology, national institutional conditions, or the legal force of a norm. Literature addressing the laws of individual states in the United States is also not treated as comparative federal law.

The materials were collected through library and documentary research involving identification, compilation, verification, classification, and systematization ([Sampara & Husen, 2016](#); [Irwansyah, 2020](#)). Qualitative analysis was conducted through legal interpretation, legal reasoning, conceptual analysis, case analysis, and functional comparison. The analytical stages included determining the relevant legal propositions, classifying the formation and forms of evidence, and examining experts, data, methods, application, inference, and rights protection. The synthesis classified each element as part of the law in force, strengthening through legal interpretation, or proposed legal reform. The subsequent analysis determined whether a deficiency affected a foundational admissibility requirement or only the evidentiary weight.

RESULTS AND DISCUSSION

A. Classification, Legal Functions, and Risks Associated with the Use of Neuroscientific Evidence Concerning Defendants

Neuroscientific evidence must be classified according to the source of the data and its inferential relationship with nervous-system functions. Raw data, metadata, processed results, and instrument outputs are components derived from measurement. Neuropsychological assessments, psychiatric diagnoses, behavioral observations, clinical histories, and collateral information function as supporting or contextual evidence. Examination reports and expert opinions constitute interpretations of the data. Normative legal conclusions concerning capacity and criminal responsibility remain within the authority of the judge. A visualization used solely to assist the court in understanding data does not automatically constitute a separate statutory category of evidence. These distinctions are necessary because successful authentication does not establish the reliability of a method or the accuracy of an interpretation ([Aggarwal & Jain, 2024](#); [Marcopulos et al., 2024](#); [Reddy, 2025](#)).

Each modality produces different forms of information and distinct risks of error. Computed tomography and structural magnetic resonance imaging provide anatomical information but do not directly establish functional consequences. fMRI uses changes in blood oxygenation as indirect indicators of neural activity. Positron emission tomography provides metabolic or molecular information, whereas electroencephalography records electrical activity through the scalp. The quality of examination results is affected by the equipment, protocol, processing procedures, comparison population, and purpose of the examination. Neuropsychological assessments also depend on population norms, cultural context, the defendant's effort during the assessment, and testing for symptom simulation or exaggeration. Clinical validity therefore does not directly establish the suitability of a technique for application to an individual defendant or its capacity to explain the defendant's condition at the time of the criminal offense ([Mallorquí-Ruscalleda, 2024](#); [Zheng et al., 2024](#); [Alotaibi et al., 2025](#); [Reddy, 2025](#)).

The legal function of evidence is determined by the condition of the defendant that the evidence is intended to explain, the relevant time, and the intended legal consequence. Article 38 and Article 39 of Law Number 1 of 2023, as amended by Law Number 1 of 2026, connect a mental or intellectual condition at the time of the criminal offense with sentence reduction, the imposition of a measure, or incapacity for criminal responsibility. The Explanation to Article 39 of Law Number 1 of 2023 states that an expert must be presented to explain incapacity for criminal responsibility from a medical perspective. This provision

does not transfer the authority to determine legal consequences to the expert. Under United States federal law, 18 U.S.C. § 17 regulates the insanity defense based on a severe mental disease or defect that rendered the defendant unable to appreciate the nature and quality or the wrongfulness of the defendant's acts. § 4.01 of the Model Penal Code distinguishes between cognitive and volitional capacities as comparative concepts. It is not binding law and does not regulate admissibility ([Kadir et al., 2025](#); [Morse, 2025](#)).

The relationship between neural data and a legal conclusion is established through a chain of inference. The chain includes the relationships among measurement, neurological condition, function, behavior, the condition at the relevant time, and the applicable legal category. Each relationship must be supported by a testable scientific basis. Reverse inference occurs when activity in a particular brain region is used to infer a mental process without accounting for the diversity of functions associated with that region. Findings derived from group-level studies also cannot directly determine the condition of an individual defendant ([Carrim, 2024](#); [Christensen et al., 2024](#)). Research concerning nutrition and the microbiome provides additional support for the proposition that behavior results from multifactorial relationships and cannot be explained by a single biological factor ([Prescott et al., 2024](#)). Neural data must therefore be examined together with functional assessments, medical history, observations, collateral information, performance validity, and alternative explanations ([Marcopulos et al., 2024](#); [Zhang et al., 2024](#)).

Neuroscientific evidence may support or test a diagnosis, explain functional limitations, and assist in assessing treatment needs. At the same time, its use may disclose sensitive data, cause stigmatization, and affect assessments of behavioral risks attributed to the defendant. Mental privacy and cognitive liberty provide principles for assessing the collection, storage, disclosure, and reuse of data. Reliance on these principles does not imply that they have been uniformly recognized as positive rights in every legal system ([Farahany, 2023](#); [Mishra, 2024](#); [García-López et al., 2025](#)). These risks do not justify the automatic exclusion of neural data or brain images. The object of an admissibility determination remains a particular claim formed through data, method, application, and interpretation to explain a particular legal proposition concerning the defendant.

B. Adequacy of Indonesian Law in Functional Comparison with United States Federal Law

A functional comparison begins by identifying the legal issue regulated by each system. It does not presume that either system is superior. Article 3 of Law Number 20 of 2025 determines the scope of criminal procedure law within courts

of general jurisdiction. It does not provide a substantive basis for admissibility. Rule 1101 of the FRE determines the applicability of the federal evidentiary rules and their exceptions. Rule 104(a) of the FRE authorizes the court to determine preliminary questions concerning qualification, privilege, and admissibility. On this basis, the comparison is limited to the function of admitting evidence at trial. Processes occurring during investigation are considered only insofar as the formation of evidence affects its lawful acquisition, integrity, or the ability of the parties to challenge it.

At the substantive level, Article 38 and Article 39 of Law Number 1 of 2023, as amended by Law Number 1 of 2026, determine the conditions, capacities, relevant time, and legal consequences that constitute the objects of proof. As a comparator, 18 U.S.C. § 17 specifies the elements of the federal insanity defense. It also requires the defendant to prove that defense by clear and convincing evidence, meaning a standard of proof higher than a balance of probabilities but lower than proof beyond a reasonable doubt. This burden applies to the defense on the merits. It must be distinguished from the obligation imposed on the party offering expert testimony to establish that the admissibility requirements under Rule 702 have been satisfied. Both systems require a relationship between a scientifically described condition and an applicable legal category. They do not, however, prescribe identical formulations of capacity or identical legal consequences.

Indonesian law regulates the formation and forms of evidence through several provisions. Article 55, Article 56, and Article 57 of Law Number 20 of 2025 regulate technical assistance during investigation for scientific proof, including forensic medicine and forensic psychology. These provisions do not establish scientific reliability requirements for every examination result. They also do not provide general authority to compel a neuroscientific examination. Article 235, Article 238, Article 239 letter c, and Article 242 of Law Number 20 of 2025 permit data, images, metadata, reports, written expert statements, and oral opinions to be classified according to their characteristics and evidentiary functions. Article 235 section (1) letter h of Law Number 20 of 2025 provides a functional basis for connecting an object with an evidentiary purpose. It does not, however, establish a general definition of relevance or the consequences of relevance comparable to Rule 401 and Rule 402 of the FRE.

Article 235 section (3) to section (5) of Law Number 20 of 2025 regulate authentication and the assessment of the acquisition of evidence. Law Number 17 of 2023 and Government Regulation Number 28 of 2024 regulate the confidentiality and disclosure of health information. Law Number 27 of 2022 regulates the legal basis, purposes, limitations, and confidentiality of data processing. These provisions regulate data provenance, access, integrity, and use. Nevertheless, a component

that is authentic and lawfully obtained does not necessarily satisfy scientific reliability requirements. Rule 901 of the FRE similarly regulates authentication, whereas Rule 703 governs the basis of an expert opinion. The distinct functions of these provisions demonstrate that authentication, data integrity, relevance, reliability, and lawful acquisition must be assessed separately.

Expert qualifications and data sufficiency reveal comparable regulatory functions but different levels of detail. Article 1 point 51 of Law Number 20 of 2025 provides that an expert's qualifications may derive from education, certification, experience, and specialized skills. Article 210, Article 214, Article 229, Article 230, and Article 238 of Law Number 20 of 2025 provide mechanisms for offering, examining, and limiting testimony according to the expert's field, as well as for presenting new materials and conducting a re-examination. These mechanisms permit scrutiny of expert opinions. They do not, however, establish the sufficiency of facts or data as an independent minimum admissibility requirement. Rule 702(b) of the FRE expressly requires sufficient facts or data, whereas Rule 703 regulates the bases reasonably relied upon by experts. The assessment of neuroscientific evidence must therefore encompass data quality, examination conditions, the comparison population, findings inconsistent with the claim, performance validity, and the correspondence between the expert's competence and the technique and claim at issue ([Aggarwal & Jain, 2024](#); [Marcopulos et al., 2024](#); [Zheng et al., 2024](#)). The kleptomania case is used only by analogy to demonstrate that a diagnostic label or brief written statement cannot replace an adequate examination ([Rivanie et al., 2022](#)).

The principal deficiency concerns the absence of integrated regulation of methodological reliability, individual application, and inferential relationships. Rule 702, following the amendment that took effect on December 1, 2023, requires the party offering expert testimony to establish that the admissibility requirements are more likely than not to have been satisfied. Daubert identifies criteria that include testability, peer review, error rates, standards, and professional acceptance. *Kumho Tire* applies reliability scrutiny to all forms of specialized knowledge. *Joiner* examines the relationship between data and conclusions. *Semrau* demonstrates that the general validation of fMRI does not resolve issues concerning protocol, error rates, real-world conditions, individual application, and the relationship to the particular case. The Sixth Circuit decision did not establish a nationwide prohibition against fMRI. Indonesian law provides mechanisms for examining an expert. It does not, however, integrate all of these functions as minimum requirements for admitting evidence ([Christensen et al., 2024](#); [Kurtz & Pintarelli, 2024](#); [Alotaibi et al., 2025](#)).

Rule 403 of the FRE regulates the balancing of probative value against the risks of unfair prejudice, confusion, misleading the factfinder, delay, waste of time, or cumulative presentation. Rule 107 governs illustrative aids used to assist the court in understanding evidence or argument and expressly provides that such aids are not evidence. This distinction is relevant when brain images, diagrams, or animations are used to explain an expert opinion. Indonesian law provides partial legal bases through the defendant's rights under Article 142 letter e, letter j, and letter o of Law Number 20 of 2025, personal data protection provisions, the prohibition against using evidence that is not authentic or has been unlawfully obtained, and the obligation to provide reasons under Article 50 section (1) of Law Number 48 of 2009. These provisions do not establish a general balancing standard or a basis for exclusion due to scientific unreliability equivalent to that under United States federal law. Table 1 summarizes the comparison.

Table 1. Functional Comparison of Controls Governing the Admissibility of Neuroscientific Evidence

Regulatory Function	Indonesian Law	United States Federal Law	Comparative Finding
Procedural scope	Article 3 of Law Number 20 of 2025 determines the scope of criminal procedure law within courts of general jurisdiction.	Rule 1101 of the FRE determines the applicability of the FRE and its exceptions.	The comparison is limited to the function of admitting evidence at trial.
Substantive legal proposition	Article 38 and Article 39 of Law Number 1 of 2023 determine the relevant condition, capacity, time, and legal consequence.	18 U.S.C. § 17 determines the elements and burden of proof governing the federal insanity defense.	Substantive norms determine the facts to be proved, not the requirements for admitting expert testimony.
Formation of evidence	Article 55 to Article 57 of Law Number 20 of 2025 regulate technical assistance during investigation for scientific proof.	The formation and acquisition of evidence are subject to other applicable federal laws and procedures according to the type of examination.	Regulation of scientific proof does not establish scientific reliability requirements.
Evidentiary unit and form of presentation	Article 235, Article 238, Article 239 letter c, and Article 242 of Law Number 20 of 2025 regulate statutory categories and forms of presenting evidence.	Rule 107, Rule 702, Rule 703, and Rule 901 of the FRE distinguish illustrative aids, expert testimony, bases of opinions, and authentication.	Evidentiary components must be distinguished from illustrative aids used solely to assist understanding.
Relevance	Article 235 section (1) letter h of Law Number 20 of 2025 provides a functional basis for evidentiary purposes.	Rule 401 and Rule 402 of the FRE regulate the definition and consequences of relevance.	Indonesian law does not provide an equivalent general formulation of relevance.
Determination of preliminary questions	Article 235 section (4) of Law Number 20 of 2025 authorizes the judge to assess the authenticity and the lawfulness of the acquisition of evidence.	Rule 104(a) of the FRE authorizes the court to determine preliminary questions concerning qualification and admissibility.	Indonesian law does not regulate a dedicated examination of scientific reliability.

Regulatory Function	Indonesian Law	United States Federal Law	Comparative Finding
Expert qualifications	Article 1 point 51, Article 210, Article 229, and Article 238 of Law Number 20 of 2025 regulate qualifications, the offering of expert testimony, the oath, and the limits of expertise.	Rule 702 of the FRE regulates the bases for expert qualification.	An expert's personal qualifications do not establish the reliability of every opinion expressed.
Burden and minimum scientific requirements	Indonesian law does not specifically regulate the party bearing the burden or the minimum scientific reliability requirements.	Rule 702 of the FRE, as amended in 2023, places the burden of establishing the requirements on the party offering expert testimony.	The federal burden and standard are not directly applicable in Indonesia.
Data sufficiency	Article 214 and Article 230 of Law Number 20 of 2025 provide for examination, clarification, the presentation of new materials, and re-examination.	Rule 702(b) of the FRE requires sufficient facts or data, whereas Rule 703 regulates the basis of an expert opinion.	Indonesian examination mechanisms do not establish data sufficiency as an independent requirement.
Methodological reliability	Article 214 and Article 230 of Law Number 20 of 2025 permit scrutiny of an expert opinion without defining methodological reliability criteria.	Rule 702(c) of the FRE, Daubert, and Kumho Tire govern the examination of principles and methods.	Federal criteria serve only as persuasive comparators and must correspond to the technique and claim.
Reliability of application	Article 214, Article 230, and Article 238 of Law Number 20 of 2025 provide mechanisms for examination and limitations based on the expert's field.	Rule 702(d) of the FRE, Joiner, and Semrau examine the application of methods and the relationship between data and conclusions.	General validity must be distinguished from the application of a method to a particular defendant and case.
Inferential relationship	Article 38 and Article 39 of Law Number 1 of 2023 and Article 235 of Law Number 20 of 2025 determine the substantive purpose and evidentiary function.	Rule 702(a) of the FRE, Daubert, and Joiner require expert testimony to assist the factfinder and to have an adequate inferential basis.	The data must have a scientifically supportable relationship with the function assessed, the defendant's condition at the relevant time, and the legal category to be proved.
Authentication, integrity, and acquisition of evidence	Article 235 section (3) to section (5) of Law Number 20 of 2025, together with health and data-protection provisions, regulate authentication, acquisition, confidentiality, and data processing.	Rule 901 of the FRE governs authentication, whereas the lawfulness of acquisition is governed by other applicable law.	Authentic and lawfully obtained data do not necessarily produce a reliable opinion.
Risks associated with use and defendants' rights	Article 142 of Law Number 20 of 2025 and health and data-protection provisions provide partial legal protection.	Rule 403 and Rule 107 of the FRE regulate risks associated with evidence and illustrative aids.	Indonesian law does not provide a general balancing standard between probative value and risks associated with use.

Regulatory Function	Indonesian Law	United States Federal Law	Comparative Finding
Legal consequences and obligation to provide reasons	Article 235 section (5) of Law Number 20 of 2025 regulates the consequences of evidence that is not authentic or has been unlawfully obtained. Article 50 section (1) of Law Number 48 of 2009 requires judgments to state their reasons and legal bases.	Rule 104(a), Rule 702, and Rule 403 of the FRE and Joiner concern admissibility determinations, limitations, and review.	Exclusion based on scientific unreliability and claim-specific and component-specific rulings require legal reform.

Source: Compiled by the author from primary legal materials.

The comparison demonstrates that Indonesian law regulates statutory categories of evidence, mechanisms for producing scientific evidence, expert qualifications, examination by the parties, authentication, lawful acquisition, confidentiality, personal data protection, and the obligation to provide reasons. The principal issue is not the complete absence of regulation. It is the failure to integrate the burden borne by the party offering the evidence, data sufficiency, methodological reliability, reliability of application, inferential relationships, risk balancing, and the consequences of scientific unreliability. The reconstruction must therefore be based on Indonesian law. United States federal law is used solely to identify regulatory functions that Indonesian law has not adequately addressed (Bakhtiar, 2024; Reddy, 2025).

C. Reconstruction of the Elements of the Admissibility Standard for Neuroscientific Evidence Concerning Defendants

The reconstruction concerns the admission of neuroscientific evidence concerning defendants during court proceedings. Examination or data formation at an earlier stage is assessed only insofar as it affects authentication, lawful acquisition, data integrity, reliability, and the ability to challenge the evidence. The proposed model does not directly adopt Rule 702 or federal case law. Its legal basis consists of Indonesian provisions governing statutory means of evidence, experts, authentication, defendants' rights, health data, the acquisition of evidence, and the obligation to provide reasons. These provisions are analyzed together with scientific examination requirements. Each element is classified as part of the law in force, strengthening through legal interpretation, or proposed legal reform. This classification prevents courts from exercising coercive authority or establishing new grounds for exclusion without a conferral of authority through laws and regulations.

The first set of elements concerns the purpose and legal proposition, the authority to conduct the examination, the legal basis for processing data, authentication, and traceability. The party offering the evidence must explain

its intended use. The purpose may include explaining the defendant's mental condition at the time of the criminal offense, functional capacity, the need to impose a measure, or another proposition supported by an independent legal basis. The connection between the defendant's identity and the raw data, equipment, software, storage processes, processing procedures, outputs, reports, and expert opinions must be traceable. A legal basis and lawful access to data do not establish scientific reliability. Consent is also not the only possible basis for processing data. Each action must be supported by authority, a specified purpose, necessity, limitations, and accountable forms of protection ([Farahany, 2023](#); [Mishra, 2024](#)).

The subsequent elements concern expert qualifications, data sufficiency, methodological reliability, and reliability of application. The expert's competence must correspond to the modality, type of data, population, forensic evidentiary context, and legal proposition to be explained. A clinical degree or the ability to operate equipment does not establish competence to draw inferences concerning legal categories. Data sufficiency encompasses recording quality, examination conditions, the comparison population, data inconsistent with the claim, and performance validity. Methodological reliability encompasses testability, standardization, error rates, peer review, and quality control. Reliability of application encompasses protocols, equipment, the defendant's condition, data processing, deviations, and the limits of the opinion. The applicable criteria must correspond to the characteristics of the modality, method, and scientific claim without eliminating the obligation to examine reliability ([Aggarwal & Jain, 2024](#); [Marcopulos et al., 2024](#); [Zheng et al., 2024](#); [Alotaibi et al., 2025](#)).

The inferential relationship must explain the connections among the data, neurological condition, function, behavior, condition at the relevant time, and applicable legal category. An opinion that equates a biological correlation with incapacity for criminal responsibility must be limited. The same limitation applies to conclusions that extend beyond the data and method used. The examination must also integrate clinical history, behavioral observations, neuropsychological assessments, collateral information, performance validity, and alternative explanations ([Christensen et al., 2024](#); [Zhang et al., 2024](#); [Morse, 2025](#)). Probative value must then be assessed in relation to the risks of misleading the court, stigmatization, excessive disclosure, and secondary use. These risks may be reduced by limiting the scope of the opinion, using visualizations solely as illustrative aids, de-identifying information, restricting access, or conducting a closed hearing. The right to challenge evidence does not justify unrestricted access. Conversely, confidentiality provisions must not be invoked to eliminate the minimum access necessary to fairly examine the basis of an expert opinion ([McLawsen, 2025](#)).

Table 2. Reconstructed Elements of the Admissibility Standard for Neuroscientific Evidence

Element of Examination	Object of Examination	Normative Status	Consequence
Purpose and legal proposition	The function of the evidence, the time of the condition assessed, and the legal fact to be proved	Law in force and strengthening through legal interpretation	A claim that has no relationship with the legal proposition to be proved must be limited or disregarded under the applicable provisions.
Lawfulness of the examination and data processing	Authority, legal basis for processing, purpose, access, and disclosure	Law in force	Legal consequences apply in accordance with laws and regulations.
Authentication and traceability	The defendant's identity, data, equipment, processing procedures, outputs, and reports	Law in force and strengthening through legal interpretation	An unauthenticated component may not be used. A traceability deficiency is assessed according to its effect on data integrity and the claim.
Expert qualifications	Education, experience, technique, forensic context, and conflicts of interest	Law in force and strengthening through legal interpretation	The scope of the expert opinion is limited according to the expert's competence.
Data sufficiency	Data quality, examination conditions, the comparison population, and inconsistent findings	Strengthening through legal interpretation, whereas specific minimum requirements require legal reform	A deficiency is assessed according to its effect on a foundational requirement of the claim or its evidentiary weight.
Methodological reliability	Testability, peer review, error rates, standards, and quality control	Strengthening through legal interpretation, whereas specific minimum requirements require legal reform	Under the proposed model, a method that is unreliable for the intended use renders the claim inadmissible.
Reliability of application	Protocols, individual conditions, equipment, analysis, and deviations	Strengthening through legal interpretation, whereas specific minimum requirements require legal reform	Under the proposed model, a deficiency in a foundational requirement renders the claim unusable. A limited deficiency requires the scope of the expert opinion to be restricted.
Inferential relationship	The relationship among data, function, behavior, time, and the legal category	Strengthening through legal interpretation	An inference unsupported by an adequate scientific relationship must be limited.
Integration of data and alternative explanations	Clinical data, behavior, collateral information, performance validity, and other causes	Strengthening through legal interpretation	A deficiency is assessed according to its effect on a foundational requirement of the claim or its evidentiary weight.
Probative value, risks, and rights	Risks of misleading the court, stigmatization, privacy, access, and alternative forms of presentation	Partially governed by the law in force, whereas general balancing requires legal reform	The form of presentation may be limited under existing provisions. Exclusion based on scientific unreliability requires a legal basis.
Capacity to challenge and obligation to provide reasons	Necessary access, examination, rebuttal expert testimony, and the judge's reasons	Partially governed by the law in force and subject to proposed legal reform	Expert testimony must be capable of meaningful challenge. An admissibility ruling must state reasons that can be reviewed through legal remedies.

Source: Compiled by the author from primary and secondary legal materials.

The reconstructed standard does not adopt the more-likely-than-not requirement under Rule 702 of the FRE. A deficiency in a foundational requirement exists when it concerns authentication or the acquisition of evidence as required by law, data sufficiency, methodological reliability, reliability of application, an inferential relationship, or the capacity to challenge evidence, and the deficiency cannot be remedied. Evidence may not be used when the law in force prescribes that consequence, including when the evidence is not authentic or has been unlawfully obtained. Exclusion based on scientific unreliability that has not been regulated requires a new legal basis. A residual weakness exists when the foundational requirements have been satisfied but remaining uncertainty reduces the strength of the claim. Such a weakness affects evidentiary weight. A deficiency limited to a particular component or inferential scope requires the scope of the opinion to be restricted. A remediable deficiency permits lawful supplementation or adjournment.

D. Procedural Mechanism and Requirements for Implementing the Admissibility Standard

The procedural mechanism distinguishes three normative categories. The law in force regulates statutory categories of evidence, authentication, lawful acquisition, experts, defendants' rights, confidentiality, personal data, and the obligation to provide reasons. Strengthening through legal interpretation may be used to distinguish evidentiary components, limit the scope of expert opinions, examine inferential relationships, and distinguish admissibility from evidentiary weight. Proposed legal reforms include assigning the burden to the party offering the evidence, requiring pretrial notice, establishing a dedicated admissibility hearing, requiring disclosure of the scientific basis, providing a general balancing standard, and requiring component-specific and claim-specific determinations. Coercive measures, restrictions on rights, and new grounds for exclusion must be prescribed by laws and regulations. The Supreme Court of the Republic of Indonesia may regulate the administration of court proceedings only within the authority conferred by laws and regulations.

Under the proposed model, the party offering the evidence may be the public prosecutor, the defendant, or defense counsel. That party must explain the provenance of the data, the examination procedure, legal purpose, technique, evidentiary components, claim, expert qualifications, data, method, application, and limitations of the opinion. A dedicated hearing is required when a material scientific dispute exists. It is also required when the evidence involves a technique that has not attained sufficient validation and professional acceptance for the stated forensic purpose, data that cannot readily be examined, a scientific claim that may determine an assessment of a material issue in the case, or a serious

risk to the defendant's rights. Disclosure encompasses raw data, metadata, protocols, processing documentation, validation results, and the scientific literature underlying the expert opinion. Article 142 letter e, letter j, and letter o of Law Number 20 of 2025 protect the defendant's right to provide or decline to provide information, obtain access to a physician, and present a person with specialized expertise. These provisions do not provide a legal basis for a compelled examination.

Administrative review is limited to assessing document completeness and compliance with deadlines for offering and disclosing evidence. Court clerks do not assess scientific quality. The judge determines the disputed issues and examines each element of the standard. Materials that have not been declared usable may not form part of the reasoning of the judgment. The quality and consistency of the reasons and their relationship with the applicable legal propositions are more important than the number of experts or documents. [Simamora et al. \(2026\)](#) are used by analogy to support the need for consistent judicial reasoning, not to determine the reliability of neuroscience. Table 3 summarizes the procedural mechanism.

Table 3. Procedural Mechanism for Examining the Admissibility of Neuroscientific Evidence

Stage	Responsible Actors	Principal Action	Result	Normative Status
Initial classification	The party offering the evidence and the expert	Explain the purpose, technique, components, claim, and role of the expert	Defined scope of examination	Strengthening through legal interpretation
Administrative review	Court clerks	Examine document completeness and compliance with applicable deadlines	The submission is declared complete or returned to the party offering the evidence for supplementation	Proposed procedural reform
Controlled disclosure	The party offering the evidence and the party lawfully holding the data	Provide relevant materials and identify confidentiality requirements	Access restricted according to the needs and purpose of the examination	Partially governed by the law in force and subject to proposed legal reform
Objection and response	The public prosecutor, defendant, or defense counsel, depending on the party offering the evidence	Identify disputes concerning qualifications, data, methods, inference, and rights	List of issues requiring examination	Partially governed by the law in force and strengthened through legal interpretation
Dedicated hearing	The judge, parties, and experts	Examine the disputed elements	Record of the admissibility findings	Proposed legal reform

Stage	Responsible Actors	Principal Action	Result	Normative Status
Supplementation or clarification	The party offering the evidence and the expert	Remedy deficiencies without improperly altering the data	The claim is declared complete, its scope is restricted, or its examination is terminated	Strengthening through legal interpretation, whereas a specific procedure requires regulation
Component-specific and claim-specific determination	The judge	Apply mandatory requirements and criteria appropriate to the modality	The evidence or claim is admitted, limited, supplemented, deferred, or excluded	Consequences supported by an existing legal basis apply under the law in force; other consequences constitute proposed legal reform
Control over use	The judge, parties, experts, and court clerks	Monitor the limits of the opinion, data access, use of illustrative aids, and the record of proceedings	Evidence is used within the limits determined by the judge, and a record is available for review through legal remedies	Partially governed by the law in force and subject to proposed legal reform

Source: Developed by the author from the results of the analysis.

Implementation of the procedural mechanism requires national minimum standards, referral networks, and facilities that satisfy accreditation requirements, equipment standards, quality-control requirements, data-security requirements, and personnel-competence standards. It also requires experts who are free from conflicts of interest and capable of providing opinions in accordance with professional standards and their fields of expertise. Funding for expert assistance must be available to defendants who lack financial means. Certification, registration, or other forms of professional recognition, facility accreditation, and judicial assessment of expert qualifications perform distinct functions. Health and data-protection provisions provide legal bases for data security, integrity, availability, confidentiality, and restricted processing. Specific retention periods, access logging, audits, and destruction of case-related data should be formulated through strengthened governance or legal reform when they are not expressly required by existing provisions. Findings concerning limitations in personnel, facilities, and coordination support only the proposition that legal reform requires institutional support. They do not establish uniform conditions in forensic neuroscience throughout Indonesia (Fernando et al., 2025; Oktavirgianti & Pratama, 2026; Syahfallah et al., 2026).

The normative model must not be implemented as an experimental procedure in an actual case before the necessary legal basis and protective mechanisms have been established. Simulations, retrospective studies, and testing of the administrative procedure must precede a limited pilot program. A pilot program

may proceed only after the necessary legal basis, protocols, oversight, rights protections, expert assistance, stopping criteria, and termination procedures have been established. Evaluation must address the consistency of reasons, duration, costs, data security, equality of access, quality of expert assistance, and frequency of limitations or exclusions. The evaluation results must be open to examination, criticism, and revision before broader implementation. These stages are necessary to ensure that the proposed legal reform remains empirically testable and is not declared effective before supporting research has been completed.

CONCLUSIONS AND SUGGESTIONS

Neuroscientific evidence concerning a defendant does not constitute a new statutory category of evidence and may not be admitted automatically. Raw data, processed data, examination reports, expert opinions, and illustrative aids perform distinct functions. A diagnosis or brain abnormality does not directly establish legal capacity or criminal responsibility. Indonesian law regulates substantive legal propositions, experts, authentication, the lawful acquisition of evidence, defendants' rights, health information, data protection, examination by the parties, and the obligation to provide reasons in judgments. It does not, however, integrate data sufficiency, methodological reliability, reliability of application, inferential relationships, and risks associated with use as specific admissibility requirements.

The reconstructed standard consists of eleven elements: the purpose and legal proposition; the lawfulness of the examination and data processing; authentication and traceability; expert qualifications; data sufficiency; methodological reliability; reliability of application; inferential relationships; integration of data and alternative explanations; probative value, risks, and rights; and the capacity to challenge evidence and the obligation to provide reasons. A deficiency in a foundational requirement produces consequences under the law in force when an applicable legal basis exists. Exclusion based on scientific unreliability that has not been regulated requires legal reform. Residual weaknesses affect evidentiary weight. A limited deficiency may require restrictions on an evidentiary component or the scope of an expert opinion.

The legislature should regulate the legal basis for compelled examinations, the burden borne by the party offering the evidence, the disclosure of sensitive data, dedicated admissibility hearings, the consequences of scientific unreliability, and component-specific and claim-specific determinations. The Supreme Court of the Republic of Indonesia may regulate the administration of court proceedings within the authority conferred by laws and regulations. The government, professional organizations, and accreditation bodies should establish coordinated standards for data security, expert competence, examination protocols, facility quality, and referral

networks. Funding for expert assistance must also be available to defendants who lack financial means.

The limitations of normative legal research preclude definitive conclusions concerning effectiveness, costs, institutional readiness, the geographical distribution of experts and facilities, and the effects of the model on legal practice. Further research should identify and analyze judicial decisions, assess the availability and quality of facilities, analyze costs, interview stakeholders, and test the model through simulations and retrospective studies. These examinations must precede a limited pilot program. Empirical research is necessary to ensure that the proposed standard protects defendants' rights, preserves the integrity of the evidentiary process, and can be implemented proportionately.

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