

## Role of Artificial Intelligence in Medical Jurisprudence: Opportunities & Challenges

Ninad Vilas Nagrale<sup>1</sup>, Venkatesh J<sup>2</sup>, Arijit Dey<sup>3</sup>, Oinam Gambhir Singh<sup>4</sup>

### How to cite this article:

Ninad Vilas Nagrale, Venkatesh J, Arijit Dey *et al.* Role of Artificial Intelligence in Medical Jurisprudence: Opportunities & Challenges. RFP Journal of Hospital Administration. 2024;8(1):15-18.

### Abstract

The upcoming Industrial transformation will be distinguished by the dominion of Artificial Intelligence (AI). The domain of Medical Jurisprudence is pivotal to criminal inquiries. AI has the capability to prevail over countless of the constraints linked with the conventional procedures of regulating post-mortem examinations & framing inferences. AI will be pivotal in framing various inferences of medico-legal significance in Medical juridical approaches such as toxicological examination, collection of various specimens of medico-legal significance from cavities, recognition of pathologies in various organs, recognition of various stains, recognition of a weapon of offence, post-mortem interval calculations & so on. AI can also be incorporated into presently used investigation & examination approaches to speed up & boost the precision of the procedure as a whole. AI will play a pivotal role in Medical Jurisprudence in future.

**Keyword:** Medical Jurisprudence; AI; Medico-Legal Post-Mortem Examination; Toxicology.

## INTRODUCTION

The 4<sup>th</sup> Industrial transformation is drastically modifying several quarters today. The latest mainstay of all computational transfiguration projects is AI. The utilization of AI has raised over the past couple of years across a huge range of industrial sectors, including health-care services. Now-a-days, AI is being used to recognize various carcinomas, track & recognize vital clinical features, & even help doctors detect & diagnose patients more precisely. The utilization of AI in the examination

of biological materials has enormous probability in the domain of toxicology. AI has the probability to transform the domains of Medical Jurisprudence since it can help experts in their individual domains with strenuous analytical functions.<sup>1,2</sup> This paper examines the probable consequences of AI on the domains of Medical Jurisprudence, as well as the situations that must be met for AI to have a pivotal impact in these domains.

### Terminologies Related to AI

AI: The earliest definition, furnished by its creator Alan Turing, was given as the science & engineering of developing smart tools, particularly smart computer programs. As of right now, a precise definition might be an organization's (computer) capacity to accurately read outside information & utilization of that information to modify itself in a flexible way to accomplish particular objectives.

Machine Learning (ML): The statistical procedure of fitting models to information & learning via instruction models on information is known as Machine learning.

Precision therapeutics: predicting the course

**Authors Affiliation:** <sup>1</sup>Additional Professor, <sup>2</sup>Assistant Professor, <sup>3</sup>Associate Professor, <sup>4</sup>Professor, Department of Forensic Medicine & Toxicology, All India Institute of Medical Sciences, Kalyani 741245, West Bengal, India.

**Coresponding Author:** Ninad Vilas Nagrale, Additional Professor, Department of Forensic Medicine & Toxicology, All India Institute of Medical Sciences, Kalyani 741245, West Bengal, India.

**E-mail:** ninad.rmt@aiimskalyani.edu.in

**Received on:** 30.07.2024

**Accepted on:** 23.08.2024



This work is licensed under a Creative Commons  
Attribution-NonCommercial-ShareAlike 4.0.

of therapy that will most likely have the greatest impact on the patient. It is the area of therapeutics where tool learning is most frequently applied. A set of instruction information for which the end variable (such as the onset of a disease) is known is necessary for precision therapeutics to function. This procedure is known as supervised learning.

**Deep Learning (DL):** A deep neural matrix with a specific configuration of neurons arranged in multiple successive layers is known as a deep learning matrix, which is a subcategory of tool learning.

## REVIEW

### *What is Medical Jurisprudence?*

The utilization of medical speciality to criminal inquiries, administration of justice & the legal organization is known as Medical jurisprudence which also includes toxicology. Toxicology's principal objective is to investigate how chemicals, both naturally occurring & manufactured, affect human health. Toxicology has countless sub-specialties.<sup>3,4</sup>

### AI IN MEDICAL JURISPRUDENCE:

Developing smart tools with cognitive capabilities is a constituent of AI. The traditional post-mortem examination procedure has countless disadvantages, including the want for expert person in each instance, the probability for human variance in the phrasing of inferences at some stages, & the incapacity to see meticulous details with the naked human eye. To counter these, medical jurisprudence experts urgently need to apply innovative technologies. Tool learning includes deep learning, which has the ability to learn from images. This can be applied to calculate the age of skeletal bones. The three-dimensional conventional neural matrix, or 3D CNN, is highly utilized for medico-legal anthropological functions & is capable of performing both generative & descriptive functions. It learns in three dimensions. By estimating soft tissue thickness from the skulls, it can be utilized in medical jurisprudence to detect age, sex, vector forecasts, & cephalometric landmark annotations. Cone Beam Computed Tomography scans of the head are typically the source of input. It is a superior organization with no subjective bias & no fatigue. It can also be helpful in cases of sudden death by assessing hard tissues & hidden damage that might

have contributed to the death.

In the domain of medical jurisprudence, recognition is pivotal since it's needed to recognize criminals, recognize a dead person who is unknown, & recognize victims of catastrophes both natural & manmade. The conventional procedure of recognition includes physical marks, scars, tattoos, anthropology, & face descriptions etc. DNA examination & finger-printing are two landmark procedures that have been developed. However, the development of AI has made it possible for tools to verify recognition. A tool will electronically record information when it receives input of different body factors, such as finger-prints, retinal arrangements, & face traits. The tool can utilize AI to detect a person's recognition by employing these variables, which are already electronically stored in the organization. For the purpose of establishing identity, a tool can be furnished a variety of variables, such as voice, palm print, DNA, facial features, iris, finger-print, & gait arrangements. Biometry is the recognition of a person based on biological information. When a person presents the computer with their unique bio-metric arrangement for example, their finger-print, it will instantly recognize them by contrasting it to the bio-metric arrangement that it has already stored. Therefore, by contrasting the bio-metric arrangement presented to a tool with the bio-metric information already stored at the tool, a person's identity can be substantiated. The organization will need the bio-metric information of every person living in a specific area in order to apply this methodology to a huge population. This bio-metric procedure will be very helpful in establishing a person's identity.<sup>5-7</sup>

A more recent development in the realm of medical jurisprudence is the application of AI to enhance virtual post-mortem examinations. CT & MRI scans will be utilized to help tool learning algorithms obtain images of the body. Based on the photos, the tool will detect the diseased state of an organ by contrasting it with the large quantity of input information that it has been given. After processing the information, the organization will detect the organs' illness state & probably even the reason of death. One can formulate inferences about deep injuries, small fractures, organ disease, & tissue inflammation.

By examining the extent of the damage & contrasting it with the diverse arrangements of damage caused by other weapon kinds, the approach can also furnish an inference about the sort of weapon employed. Additionally, the

methodology will aid in the gathering of specimens from specific organ diseased locations & aid in the establishment of a precise disease diagnosis. In the domains of medical jurisprudence & criminal inquiry, the computation of time since death is a pivotal constituent. Blood contains a number of determinants that can be utilized to calculate the time since death. An AI organization can procedure these blood signs to furnish an accurate assessment about the period since death. Different body specimens can be processed using a variety of modern chemical examination methodologies for medico-legal toxicological examination. A few of the procedures include high-accomplishment liquid chromatography, chromatography, neutron activation examination, & light spectroscopy.<sup>8,9</sup> An algorithm suite is fed into a tool so that it can analyse the specimen more accurately & with less time investment than it would have with a conventional examination procedure. Certain constituents of toxicological testing can also be automated by combining AI with robotics. Robots, for instance, can be utilized to accurately gather & move specimens. Medico-legal specialists stand to gain a great deal from AI, which might boost productivity, cut expenses, boost precision, & open up new avenues for toxicological inquiry.<sup>10</sup>

In addition, AI may be applied in the following domains: (i) disease surveillance, where it can be utilized to recognize odd illness outbreaks, & (ii) disease diagnosis, where it can assist in the recognition of diseases using medical imaging methodologies like CT, MRI, & PET scans. The monitoring of pathogens, including bacteria, fungus, & other infectious diseases, as well as their evolution, is part of this. (iii) Medico-legal post-mortem examination & pathology, where AI can assist in recognizing the pathological cause of death. Pathology & post-mortem examination reports are frequently lengthy, laborious papers. By highlighting principal facts & inferences, AI can assist in condensing these materials. (iv) AI can be utilized in toxicology examination to look into the existence of substances & poisons in biological specimens including blood, urine, hair, saliva, & skin. (v) Substance Abuse: AI can detect arrangements in the substance abuse environment by utilizing substance testing software. AI can also be utilized to recognize usage arrangements that are odd or aberrant.<sup>11</sup>

The suffix "omics" is utilized in several biological domains, including toxicogen-omics, prote-omics, metabol-omics, Transcript-omics & gen-omics. Large amounts of scientific information are

involved in omics technologies, which are useful in the medico-legal area for calculating post-mortem intervals, diagnosing illnesses, & examining substance misuse & poisoning situations. Omics information from countless platforms is being used more & more in medico-legal researches across all domains. In the event of an accident, for instance, genomics research can be utilized to calculate the age of the injury by examining DNA microarray examination of the skeletal muscle specimens. The development of omics technologies, which generate vast volumes of information in the domains of gene expression, protein measurement, metabolite levels, & microbial interaction, has benefited in the boost of biological & medical research. Omics information can be combined with tool learning algorithms. Later, this tool information can be utilized in medical jurisprudence to detect diseases & find different bio-determinants. Countless information types, information examination, & mathematical modelling based on omics technology can be employed in medical jurisprudence researches.<sup>12,13</sup>

**Limitations of AI in Medical Jurisprudence:** For accurate explication, an AI tool needs a considerable information feed. For the tool to be able to learn from the information & be taught in several principal areas of medical jurisprudence by medico-legal experts, high-quality, large-scale information is necessary in order for the tool to be able to evaluate post-mortem examination outcomes & furnish a sound inference. Specialists in medical jurisprudence must first manually elucidate documents & photos with principal discoveries, inferences & other information for computers.

AI is merely an automated instrument. It cannot take the place of information & human contact. Human labour will be needed for each piece of information that is furnished to the computer. Therefore, medico-legal experts will need to invest a great deal of time & effort in instruction the computer at first & ongoing information updates are also required. It's possible that different AI tools can't communicate with one another. The outcome of this could be the emergence of information silos. There will be effort duplication as an outcome. Every piece of documented proof must be presented orally by the specialist witness in a court of law. Hence, the most pivotal question in the realm of medical jurisprudence is whether the inference generated by AI will be admitted as proof in a court of law. It is well known that countless people in impoverished nations like India cannot afford access to modern healthcare facilities. Therefore,

legislators will have a very tough time developing high-tech framework in the domain of medical jurisprudence.

## CONCLUSION

Policymakers in developing nations like India will have pivotal challenges in setting up high-tech framework in the domain of medical jurisprudence because the healthcare organization is still in its infancy & is primarily concentrated in metropolitan regions. Presently, providing access to healthcare for all citizens in every region of developing nations is their top objective. Therefore, given the state of the healthcare organization in a developing nation like India, AI-assisted medical jurisprudence practice can be launched as a trial project at a few selected centres. A phased approach to expanding such a strategy to broader areas can be taken after evaluating its utility.

## REFERENCES

1. Kumar Y, Koul A, Singla R, Ijaz MF: Artificial intelligence in disease diagnosis: a systematic literature review, synthesizing framework and future research agenda. *J Ambient Intell Humaniz Comput.* 2022, 13:1-28.
2. Meetali S, Sachan D, Parthasarathi R: Artificial intelligence in clinical toxicology. *Artificial Intelligence in Medicine.* Niklas Lidströmer, Hutan Ashrafiyan (ed): Springer, Cham; 2021. 1-15.
3. Yadav M, Tiwari A: Forensic toxicology and its relevance with criminal justice delivery system in India. *Forensic Res Criminol Int J.* 2017, 4:122-8.
4. Aggrawal A: Textbook of forensic medicine and toxicology. Anil Aggrawal (ed): Avichal Publication Company, New Delhi; 2014.
5. Thurzo A, Kosnáčová HS, Kurilová V, et al.: Use of advanced artificial intelligence in forensic medicine, forensic anthropology and clinical anatomy. *Healthcare (Basel).* 2021, 9:1545.
6. Matsuda S, Yoshimura H: Personal identification with artificial intelligence under COVID-19 crisis: a scoping review. *Syst Rev.* 2022, 11:7.
7. Saini M, Kapoor AK: Biometrics in forensic identification: applications and challenges. *J Forensic Med.* 2016, 1:108.
8. Ramprabhu K, Fatangare S: Survey on prediction of post mortem interval using artificial intelligence inforensic examination. *IRJET.* 2020, 7:5760-3.
9. Hachem M, Sharma BK: Artificial intelligence in prediction of post-mortem interval (PMI) through blood biomarkers in forensic examination-a concept. *Amity International Conference on Artificial Intelligence (AICAI).* 2019, 255-258.
10. Helma C, Gottmann E, Kramer S: Knowledge discovery and data mining in toxicology. *Stat Methods Med Res.* 2000, 9:329-58.
11. Agrebi S, Larbi A: Use of artificial intelligence in infectious diseases. *Artificial Intelligence in PrecisionHealth: From concept to applications.* Debmalya Barh (ed): Academic Press, London; 2020. 415-38.
12. Akçan R, Taştekin B, Yıldırım MŞ, Aydogan HC, Sağlam N: Omics era in forensic medicine: towards a newage. *Turk J Med Sci.* 2020, 50:1480-90. 10.3906/sag-1912-197.
13. Gaballah MH, Fukuta M, Maeno Y, et al.: Simultaneous time course analysis of multiple markers based onDNA microarray in incised wound in skeletal muscle for wound aging. *Forensic Sci Int.* 2016, 266:357-68.

