A note on certain implications of clinical artificial intelligences for the field of medico-legal semiotics

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Abstract: Artificial intelligence has profound implications for the filed of clinical practices, and also for semiotics and law. In this article, we articulate and explain the different types of Clinical artificial intelligence (CAIs) as their normativity often stems from their type (symbolic or connectionist) (Harnad, 1990), and relative autonomy/agency. Older, symbolic AI, while more explainable, did not offer the potential that offer the current, second generation CAIs. The intelligibility of the reasoning used by CAIs remains largely opaque and generally unintelligible and unexplainable for human interpreters, even sometimes counter-factual (Lee & Topol, 2024). This is also true of the most recent so-called "explainable" AIs, that remains imperfect and only very

partially explainable (Reddy, 2022). The most recent literature reveals that the very question of AI explainability continues to be one of the most heavily debated concerning CAIs (Hildt, 2025). In this article, we will reveal that the solution to the black-box problem of CAIs resides in an investigation in the (bio)semiotic nature of both CAIs themselves, but also the problem that surround their explainability. We conclude with solutions to promote transparency in the use of CAIs.

Keywords: semiotics, biomedicine, AI, clinical, XAI, explainability, medicine.

The deployment of artificial intelligence in medical contexts or clinical artificial intelligences, or "CAIs", has given rise to a wide range of discussions in the literature of various disciplines, in the last years especially with the *RAISE* conference held in October 2023, jointly by *The Lancet* and the *New England Journal of Medicine*. Literature on the implications of CAIs specifically for the field of semiotics remains relatively scarce, especially when it comes to medico-legal issues. Some literature exists on the question of the challenges that face AI to truly *justify* its decision-making processes and how AI produces meaning based on which (clinical) signs (and what constitutes one), and their correspondence to empirical realities known as the symbol-grounding challenge (Harnad, 1990). Additionally, it is to be remembered that AI does not always uses symbols in their processes (Fodor & Pylyshyn, 1988), and this affects in turn their ethical and medical justifiability when deployed in health contexts (Amann, 2020). The most recent literature reveals that the very question of AI explainability continues to be one of the most heavily debated concerning CAIs (Hildt, 2025)

While facing such semiotics questions, CAIs constitute also a marked departure from the contemporary practices of medicine generally resting on evidence-based practices. First and foremost, the *intelligibility* of the reasoning used by CAIs remains largely opaque and generally unintelligible and unexplainable for human interpreters, even sometimes counter-factual (Lee & Topol, 2024, p. 717). This is also true of the most recent so-called "explainable" AIs, that remains imperfect and only very partially explainable (Reddy, 2022).

The wide-use of CAIs in clinical settings is generally regarded as a question of *when*, and not an *if*, according to a recent statement of

the American Heart Association (Maxwell, 2024). Thus, its compatibility with contemporary medico-legal standards of practice requires its intelligibility:

> In recent years, improved artificial intelligence (AI) algorithms and access to training data have led to the possibility of AI augmenting or replacing some of the current functions of physicians. However, interest from various stakeholders in the use of AI in medicine has not translated to widespread adoption. As many experts have stated, one of the key reasons for this restricted uptake is the scarce transparency associated with specific AI algorithms, especially black-box algorithms. Clinical medicine, primarily evidence-based medical practice, relies on transparency in decision making. If there is no medically explainable AI and the physician cannot reasonably explain the decision-making process, the patient's trust in them will erode. To address the transparency issue with certain AI models, explainable AI has emerged. (Reddy, 2022)

This in turns starkly contrasts with *Evidence-based medicine*, the principal form of contemporary medicine, which buttressed its gold standard on randomized clinical trials, meta-analysis, and biostatistical data (Ratnani et al., 2023), with an explicit objective, from its beginnings at McMaster University, of opening up the "black box" of medical reasoning, and (re)arranging the relative "value" of different sources as legitimate medico-legal grounds for a given diagnosis, or treatment (Oliver & Pearce, 2017). There are nevertheless promising avenues to have CAIs "learn" evidence-based medicine (Skalidis, 2023, pp. 368-369), such as in management of patient workflow (Glicksberg et al., 2024, pp. 1921-1928).

Evidence-based medicine has its most frequent expression in the forms of the various *clinical guidelines* and covers most of the contemporary practices of medicine. In fact, the very *use* of CAIs is often itself undertaken under the framework of clinical guidelines, and there are clinical guidelines both to be applied *by* and to be applied *to* CAIs. A notable example of such numerous guidelines would be the American Heart Association's, which aims at "securing the minimum level of clinical evidence required for different tiers of AI studies are necessary to eliminate variation in the quality of published studies and in the AI tools themselves." (The Lancet, 2019).

This entails that the very acceptabilty of CAIs by medicine is itself contextual in nature "*exercice cadré")* and is contained within the framework of Evidence-Based medicine and clinical trials (The

CONSORT-AI and SPIRIT-AI Steering Group, 2019, pp. 1467-1468). In other words, there are abundant clinical trials to assess the use of CAIs in a wide variety of contexts, thus integrating artificial intelligence in medicine through the prism of evidence-based medicine.

Nevertheless, CAIs have had (Busnatu et al., 2022, p. 2265), and continue to express results that are clinically significant, and that outperform, or in certain cases, perform just as well (Davenport & Kalakota, 2019, pp. 94-98; Longoni & Morewedge, 2019), as human health practitioners (human clinical intelligence?), especially when it comes for instance to matters or recognition of malignant or anormal medical imaging patterns (Bi et al., 2019, pp. 127-157; Davenport & Kalakota, 2019, pp. 94-98).

Despite these promising results, the issues remain both numerous, and pressing with the use of CAIs towards patients. This creates a new field for medical semiotics. In the most recent developments of scientific literature on the question, medical semiotics can be defined as:

> the theory that links the interior of the body to the diagnosis, and it is often in the discussion of symptoms and signs that people enter the world of biomedicine (Andersen et al., 2017). The term semiotics itself traces its roots to the Greek word semeion, which means sign or mark. (Andersen et al., 2024, pp. 91-101)

Semiotics, from its medical origins (and its later distancing from) now calls for a crucially needed (re)expansion of semiotics, which, in any case, nevertheless continued to expand to medical questions such as diagnosis and treatment practices (Burnum, 1993, pp. 939-943; Nessa, 1996, pp. 363-377), to the socially constructed or "fuzzier" types of diagnosis applied in medicine (Kwiatkowska & Kielan, 2013), notorious in the field of mental health (Kuperman & Zislin, 2005, pp. 35-50) and in the context of linguistic minorities patients (Nowak, 2019).

Beyond the Saussurian concept of "life of signs" (Thibault, 1988), the "signs of life" are one of the objects of medical semiotics, these signs themselves being alive, shifting, and socially constructed. From a semiotics perspective, it needs to be recalled that clinical health practices are a form of interpretive practices, often dialogue interpretation (DI), and call for a triadic perspective. This shift from dyad to triad is one of the key issues to better understand CAIs and their

medico-legal implications, according to two leading medical journals (Goldberg et al., 2024, pp. 623-627):

> Finding a suitable research approach to account for integrated semiotic resources in DI requires a clear conceptualization of the object of study. DI scenarios are also known as triadic exchanges (Mason, 2001) or communicative pas de trois (Wadensjö, 1998), two expressions that recognise the interpreters' visibility and fundamental responsibility with regard to the negotiation of meaning in interaction. (Davitti, 2019, pp. 7-29)

The need for semiotics in the building of the future of medicine, that is, clinical guidelines themselves and proper CAIs guidance therefore, has to be a part of any future semiotics of biomedicine. This also entails that, as of now, CAIs tend to make decisions about health based on mainly a *predictive* perspective that encompasses constant adjustments to real-world variables, and measured metrics.

The types of *clinical artificial intelligence* (CAIs) currently in real-world uses offer a new field of investigation of medico-legal semiotics in the reasoning of CAIs in diagnosis and treatment, sometimes according purely to probabilistic chances and prognosis, and the available medical resources, as is currently the main focus of what is known as *predictive* CAIs. This would altogether radically change the relative importance of accurate diagnosis, in favour of metrics of health outcomes resting on large-scale, in some cases generational, data. This would truly mark the end of the "patient", and the beginning of the dehumanized "molar" or "neutralized" (Mennella et al., 2024) patient some announced (sometimes exaggeratedly) as an inevitable outcome of the trend, now well accepted, of evidence-based medicine. Evidence-based medicine has itself been an object of recent works in semiotics and social sciences. Its consequences in terms of interpretive practices and the *type* of signs and marks, as well as the type of *guidance* they recommend, rests on an epistemology that is often different than what is learned by experience, and clinical knowledge.

One "dead angle" of current biomedical semiotics, as the literature is starting to reveal, is the context of clinical decision-making. Health practices are indeed often bound not only by medical imperatives but further shaped by pre-established taxonomies (as the notion was advanced by (Porcino & MacDougall, 2009, pp. 18-30) and considerations of medical ethics, human biases, as well as the guidance offered by recent case-law or decisions of disciplinary boards which

often carry profound effects on the shaping of practice. For instance, the importance attributed to one sign or the preference of a use of a certain procedure or guidelines for legal or administrative reasons influence human interpreters, but not in the same way CAIs.

This is not to say that CAIs will *not* suffer from biases, conflict of interests or otherwise discriminatory health practices (Hastings, 2024), but rather, the identification of such biases will require new tools and methodologies, different from their human counterpart. It is also possible to design or utilize CAIs in such a way as to enhance health equity and medical resources distribution (Johnson et al., 2022, pp. 259-273).

Sometimes, negatively, described as algorithms, it seems that clinical practice guidelines, and their interpretation through the means of semiotics, would radically enhance the clarity of the *elusive* standard of care expected to be practiced by health professionals and facilities. In other words, the disciplines of medicine and law and the theories, or sometimes, concurrent views affecting both the standard of care as stated in medicine, and the standard of care as stated in law, have implications for the semiotics of biomedicine. The very nature of the semiotics of the medical sign and symptom, and in particular its identification by an interpreter (human or not), will have implications for the development of medical reasoning and building trustworthy, and transparent (or at least explainable), CAIs:

> Perhaps the most difficult issue to address given today's technologies is transparency. Many AI algorithms – particularly deep learning algorithms used for image analysis – are virtually impossible to interpret or explain. If a patient is informed that an image has led to a diagnosis of cancer, he or she will likely want to know why. Deep learning algorithms, and even physicians who are generally familiar with their operation, may be unable to provide an explanation. (Davenport & Kalakota, 2019, pp. 94-98)

In fact, the very act of regulating CAIs might very well go *against* the iterative nature, and self-generating, nature of artificial intelligence, especially when it comes to unsupervised machine "Deep Learning" (Quer & Topol, 2024).

From a semiotics point of view, this (re)arranging of epistemic values, and the exaltation of the meta-analysis as golden standard of medical knowledge, has to be acknowledged and further studied. As shared recently in a leading medical journal (Lee & Topol, 2024, p.

717), to give a *meaningful* as well as an ethically acceptable use of CAI is key:

> Eventually, this leads to the role of the rule of law and legal regulation. The functioning of law has been fundamentally challenged by ongoing technical developments and transformations for centuries. When it comes to the implications of disruptive technologies, the decision as to whether new developments demand new legal solutions, is pressing. The risks described above strengthen the arguments for general legal regulation of AI. Moreover, AI, associated with having an opaque, complex, allegedly biased and rapidly changing character does not interact well with the legal imperatives of legal certainty, transparency, explicability and equal treatment. Failures of AI which fail to meet normative expectations can cause harm, undermine trust in the institutions they use and finally hinder its development and use. (Ruschemeier, 2023, pp. 361-376)

In conclusion, the interpretation of the scientific literature we offered leads to conclude that any acceptable use of CAIs rests on sound, transparent and evidence-based processes. This is especially true considering that the medical community itself is more agreeable to an approach resting on such guidelines (Palaniappan et al., 2024, p. 562). After all, "AI models are only as reliable as the data from which they are built, and the statistical assessment of the models is subject to limitations" (Johnson et al., 2022, pp. 259-273). This leads to further investigation of the semiotic problems and calls for additional expansion of (bio)semiotics in the question of CAIs and their triadic relationship with patients and physicians. This is, in part, in order to prevent the epistemological "black box" of medical reasoning from closing up (again).

Conflict of interest

The authors declare that there is no conflict of interest.

AI Use statement

AI was not used in the paper.

Statement of Contributions

The authors contributed equally to the preparation of the manuscript

References

The Lancet Digital Health (2019). Walking the tightrope of artificial intelligence guidelines in clinical practice. *The Lancet. Digital health*, *1*(3), e100. https://doi.org/10.1016/S2589-7500(19)30063-9

Amann, J. A., Blasimme, E., Vayena, D. & Freym V. I. Madai (on behalf of the Precise4Q Consortium) (2020). Explainability for artificial intelligence in healthcare: a multidisciplinary perspective. *BMC Med Inform Decis Mak* 20, 310. https://doi.org/10.1186/s12911-020-01332-6

Andersen, R.S., M. T. Høybye, and Risør, M.B. (2024). Expanding Medical Semiotics. *Medical Anthropology 43*(2), 91–101. https://doi.org/10.1080/01459740.2024.232489

Bi, W.L. et al. (2019). Artificial intelligence in cancer imaging: Clinical challenges and applications. *CA Cancer Journal Clinicians* *69*(2), 127–157. https://doi.org/10.3322/caac.21552

Burnum, J.F. (1993). Medical diagnosis through semiotics. Giving meaning to the sign. *Annual Internal Medicine 119*(9), 939–943.

Busnatu, Ş, Niculescu, A.-G., Bolocan, A., Petrescu, G. E. D., Păduraru, D. N., Năstasă, I., Lupușoru, M., Geantă, M., Andronic, O., Grumezescu, A. M., & Martins, H. (2022). Clinical Applications of Artificial Intelligence – An Updated

Overview. *Journal of Clinical Medicine 11*(8), 2265. https://doi.org/10.3390/jcm11082265

Davenport, T., & Kalakota, R. (2019). The potential for artificial intelligence in healthcare. *Future Healthcare Journal 6*(2), 94–98. https://doi.org/10.7861/futurehosp.6-2-94

Davitti, E. (2019). Methodological explorations of interpreter-mediated interaction: novel insights from multimodal analysis. *Qualitative Research 19*(1), 7–29. https://doi.org/10.1177/1468794118761492

Fodor, J.A., & Pylyshyn, Z.W. (1988). Connectionism and cognitive architecture: A critical analysis. *Cognition 28*(1-2), 3–71. https://doi.org/10.1016/0010-0277(88)90031-5

Glicksberg, B.S., Timsina, P., Pate, D., Sawant, A., Vaid, A., Raut, G., Charney, A. W., Apakama, D., Carr, B.G., Freeman, R., Nadkarni, G.N., & Klang, E. (2024). Evaluating the accuracy of a state-of-the-art large language model for prediction of admissions from the emergency room. *Journal of the American Medical Informatics Association 31*(9), 1921–1928. https://doi.org/10.1093/jamia/ocae103

Goldberg, C. B., Adams, L., Blumenthal, D., Flatley Brennan, P., Brown, N., Butte, A. J., Cheatham, M., deBronkart, D., Dixon, J., Drazen, J., Evans, B. J., Hoffman, S. M., Holmes, C., Lee, P., Manrai, A.K., Omenn, G. S., Perlin, J. B., Ramoni, R., Sapiro… Kohane, I. S. (2024). To do no harm — and the most good — with AI in health care. *Nature Medicine 30*(3), 623–627. https://doi.org/10.1038/s41591-024-02853-7

Harnad, S. (1990). The symbol grounding problem. Physica D: *Nonlinear Phenomena 42*(1–3), 335–346. https://doi.org/10.1016/0167-2789(90)90087-6

Hastings, J. (2024). Preventing harm from non-conscious bias in medical generative AI. *The Lancet Digital Health 6*(1), e2–e3.

Hildt, E. (2025). What Is the Role of Explainability in Medical Artificial Intelligence? A Case-Based Approach. *Bioengineering* 2025, *12*, 375. https://doi.org/10.3390/bioengineering12040375

Johnson, A. E., Brewer, L. C., Echols, M. R., Mazimba, S., Shah, R. U., & Breathett, K. (2022). Utilizing Artificial Intelligence

to Enhance Health Equity Among Patients with Heart Failure. *Heart Fail Clinics 18*(2), 259–273. https://doi.org/10.1016/j.hfc.2021.11.001

Kuperman, V., & Zislin, J. (2005). Semiotic perspective of psychiatric diagnosis. *Semiotica, 155*, 1–13. https://doi.org/10.1515/semi.2005.2005.155.1-4.1.

Kwiatkowska, M. & Kielan, K. (2013). Fuzzy logic and semiotic methods in modeling of medical concepts. *Fuzzy Sets and Systems 214*, 35–50. https://doi.org/10.1016/j.fss.2012.03.011

Lee, S.-I., & Topol, E.J. (2024). The clinical potential of counterfactual AI models. *The Lancet Digital Medicine 403*(10428), 717.

Longoni, C. and Morewedge, C. (2019). AI Can Outperform Doctors. So Why Don't Patients Trust It? *Harvard Business Review.* https://hbr.org/2019/10/ai-can-outperform-doctors-so-why-dont-patients-trust-it

Maxwell, Y. L. (2024). AHA Sums Up AI's Potential in Cardiology, but Also the Hurdles Ahead. *TCTMD*. https://www.tctmd.com/news/aha-sums-ais-potential-cardiology-also-hurdles-ahead

Mennella, C., Maniscalco, U., De Pietro, G., & Esposito, M. (2024). Ethical and regulatory challenges of AI technologies in healthcare: A narrative review. *Heliyon 10*(4), e26297. https://doi.org/10.1016/j.heliyon.2024.e26297

Nessa, J. (1996). About signs and symptoms: can semiotics expand the view of clinical medicine? *Theoretical Medicine 17*, 363–377. https://doi.org/10.1007/BF00489681

Nowak, E. (2019). Multiculturalism, Autonomy, and Language Preservation. *Ergo: An Open Access Journal of Philosophy 6*(11). https://doi.org/10.3998/ergo.12405314.0006.011

Oliver, K., & Pearce, W. (2017). Three lessons from evidence-based medicine and policy: increase transparency, balance inputs and understand power. *Palgrave Communications 3*, 43. https://doi.org/10.1057/s41599-017-0045-9

Palaniappan, K., Lin, E. Y. T., & Vogel, S. (2024). Global Regulatory Frameworks for the Use of Artificial Intelligence (AI) in the Healthcare Services Sector. *Healthcare (Basel) 12*(5), 562. https://doi.org/10.3390/healthcare12050562

Porcino, A., & MacDougall, C. (2009). The Integrated Taxonomy of Health Care: Classifying Both Complementary and

Biomedical Practices Using a Uniform Classification Protocol. *International Journal of Therapeutic Massage & Bodywork* *2*(3), 18–30. https://doi.org/10.3822/ijtmb.v2i3.40

Quer, G., & Topol, E. J. (2024). The potential for large language models to transform cardiovascular medicine. *The Lancet: Artificial Intelligence and Digital Innovaions in Cardiovascular Care* *6*(10), e767–e771. https://doi.org/10.1016/S2589-7500(24)00151-1

Ratnani, I., Fatima, S., Mohsin Abid, M., Surani, Z., & Surani, S. (2023). Evidence- Based Medicine: History, Review, Criticisms, and Pitfalls. *Cureus, 15*(2), Article e35266. https://doi.org/10.7759/cureus.35266

Reddy, S. (2022). Explainability and artificial intelligence in medicine. *The Lancet Digital Health 4*(4), E214–E215. https://www.thelancet.com/journals/landig/article/PIIS2589-7500(22)00029-2/fulltext

Ruschemeier, H. (2023). AI as a challenge for legal regulation – the scope of application of the artificial intelligence act proposal. *ERA Forum 23*, 361–376. https://doi.org/10.1007/s12027-022-00725-6

Skalidis, I., Cagnina, A. & Fournier, S. (2023). Use of large language models for evidence-based cardiovascular medicine. *European Heart Journal- Digital Health 4*(5), 368–369. https://doi.org/10.1093/ehjdh/ztad041

The CONSORT-AI & SPIRIT-AI Steering Group. (2019). Reporting guidelines for clinical trials evaluating artificial intelligence interventions are needed. *Nature Medicine 25*, 1467–1468. https://doi.org/10.1038/s41591-019-0603-3

Thibault, P. J. (1988). *Re-reading Saussure. The Dynamics of Signs in Social Life.* Routledge.