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The nurse as an agent of algorithmic equity: challenges and perspectives in the era of artificial intelligence in health

Hélder Carreira[1]

[1] PhD student in Management at the University of Beira Interior, Local Health Unit in the Leiria Region. NECE-UBI Research Centre for Business Sciences, Portugal | carreiramail@gmail.com

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Abstract

The expansion of artificial intelligence (AI)-based clinical decision support systems in healthcare raises a question that the literature has addressed inadequately: who, within healthcare organisations, is structurally positioned to detect and contest algorithmic bias at the moment it manifests? This article argues that nurses, by virtue of their continuous proximity to patients, their position at the clinical interface, and their ethical imperative of advocacy, constitute privileged agents of algorithmic equity. Nevertheless, the profession lacks a conceptual framework that articulates this responsibility with digital competencies, institutional governance mechanisms, and the emerging regulatory landscape. This paper presents a theoretical analysis that maps the evidence on algorithmic bias in health systems, grounds the nurse's singular epistemic position vis-à-vis clinical algorithms, and proposes a conceptual framework of critical algorithmic literacy oriented towards equity. Findings indicate that algorithmic bias is not an accidental technical failure but a historical artefact of structural inequalities in health systems, perpetuated when training data reflect differential access rather than actual need. A theoretical contribution is made through the notion of clinical algorithmic vigilance, proposing its curricular and institutional integration as a condition for equity in AI-mediated care.

Keywords: Algorithmic equity; Artificial intelligence in health; Nursing; Bias in decision support systems; Digital literacy; Clinical advocacy

1. Introduction

The integration of artificial intelligence (AI) systems into clinical contexts is one of the most rapid and least evaluated processes in the recent history of healthcare. In 2024, it was estimated that over 66% of North American physicians surveyed were using some form of AI in their clinical practice, and projections for nurses follow a similar trajectory (Dornan, 2025). This pace of adoption contrasts with the slowness with which the nursing profession has engaged with a central question: are clinical algorithms neutral? The answer, supported by growing and robust evidence, is unequivocally negative.

Algorithmic bias in health systems does not constitute a localisable and correctable technical anomaly. It is, rather, a historical artefact: the mathematical codification of the structural inequalities that have, for decades, marked differential access to healthcare. When Obermeyer et al. (2019) demonstrated, in the journal Science, that one of the most widely used population management algorithms in the United States generated systematic racial bias because it used healthcare costs as a proxy variable for clinical need, they exposed a logic that transcends the specificity of that instrument: algorithms trained on data

reflecting unequal access to care will learn and reproduce that inequality, even without ever explicitly including variables of race or social class.

This problem acquires particular significance in nursing practice. Nurses are, within healthcare organisations, the professionals who maintain the greatest temporal and relational proximity to patients, who continuously monitor their clinical condition, and who constitute the principal point of interface between the recommendations generated by algorithmic systems and the irreducible singularity of each person. This position is not that of a mere executor of automated alerts: it is, potentially, that of a critical interpreter, capable of detecting when an algorithmic recommendation diverges from what direct observation of the patient suggests. Nevertheless, the literature reveals that the profession does not yet possess a robust conceptual framework to situate this responsibility, nor training curricula that systematically prepare it to exercise this role (Cary et al., 2025; Economou-Zavlanos et al., 2025).

It is in this gap that the present article is situated. The central aim is to ground the nurse's singular epistemic position vis-à-vis algorithmic bias and to propose a theoretical framework of critical algorithmic literacy oriented towards equity. To this end, the article is developed in four movements: it maps the empirical evidence on algorithmic bias in health systems; it analyses the structural reasons why nurses occupy a privileged position of vigilance; it discusses the organisational and educational constraints that obstruct the exercise of that vigilance; and it proposes the notion of clinical algorithmic vigilance as a theoretical contribution to the discipline. The central argument is that equity in AI-mediated care does not depend exclusively on the technical quality of algorithms, but requires professionals deliberately prepared to contest them when necessary.

The relevance of this investigation is simultaneously theoretical, practical, and political. From a theoretical standpoint, it contributes to the conceptualisation of nursing advocacy in the algorithmic context. From a practical standpoint, it offers an orientating framework for pre- and post-graduate education. From a political standpoint, it situates the nursing profession within the European regulatory debate surrounding the European Union Regulation on Artificial Intelligence, which entered into force in August 2024.

2. Literature review

2.1. Algorithmic bias as an artefact of structural inequalities

Bias in AI systems in health does not arise at the moment of algorithmic development: it is latent in the data that feed it. Seyyed-Kalantari et al. (2021) demonstrated, in a study published in Nature Medicine, that AI systems applied to the reading of chest radiographs exhibited significantly higher underdiagnosis rates in under-represented populations, including low-income patients and minority groups. The paradox is that those same systems exhibited high overall accuracy: aggregate statistical precision masked distributional inequity. This phenomenon, which Cross et al. (2024) characterise as bias in deployment, reveals a fundamental epistemological limitation of conventional algorithmic performance indicators: they measure average adequacy, not equity.

The seminal study of Obermeyer et al. (2019) specified the mechanism with technical clarity and ethical implications that are difficult to ignore. The algorithm under analysis used historical healthcare costs as a proxy variable for future clinical need, within an ostensibly reasonable framework: those who consume more healthcare resources tend to be those who need them most. However, since Black populations structurally spend less on healthcare than White populations with the same level of illness, for reasons of unequal access rather than lower morbidity, the algorithm learned to underestimate the clinical need of the former. The result: the percentage of Black patients automatically identified for intensive care management programmes was 17.7%, when, with the bias corrected, it should have been 46.5%. A reduction of 84% in racial bias was achieved by reformulating the algorithm's objective function. This finding is central: algorithmic bias is frequently correctable, but it can only be corrected once it has been identified.

Such identification rarely occurs in the programmer's laboratory. It occurs, when it occurs, at the moment when a healthcare professional observes that the system's recommendation does not correspond to the clinical condition before them. Gianfrancesco et al. (2018) had already warned, in an analysis published in JAMA Internal Medicine, of the multiple mechanisms by which electronic health records introduce bias into machine learning models: missing data correlated with socioeconomic status, variables operationalised differently by different clinicians, and training populations that over-represent those who regularly access the health system. The question arising from this convergence of evidence is: who is positioned to detect, in everyday clinical practice, that an algorithm is failing in a systematically unequal manner?

2.2. Clinical decision support systems: potential and limits

Clinical decision support systems (CDSS) currently constitute one of the most widespread categories of AI application in healthcare organisations. Their utility is empirically documented: from the early identification of clinical deterioration to the optimisation of pharmacological management, these systems have contributed to the reduction of errors and the improvement of outcomes (Wei et al., 2025). Nevertheless, the available evidence indicates that issues of equity and algorithmic bias arise frequently in studies of the ethical implications of AI in nursing practice, particularly when systems are trained on non-diverse datasets (Cary et al., 2025).

The paradox of CDSS lies precisely in their apparent epistemic authority. An alert generated by an algorithmic system tends to be perceived as more objective and, therefore, more reliable than individual clinical judgement, which is subject to its inevitable inconsistencies. This perception may induce what the literature designates as automation bias: the tendency to uncritically accept the recommendations of an automated system, even when contradictory clinical signs are present (Cross et al., 2024). In populations that already experience systemic discrimination in healthcare, this automation bias may have grave consequences: the professional trusts the algorithm rather than trusting what their direct observation of the patient reveals.

The analysis of Chin et al. (2023), published in JAMA Network Open, reinforces this argument by proposing guiding principles for addressing the impact of algorithms on racial and ethnic health disparities. The authors emphasise that the transparency of variables used in models, the representativeness of training data, and the existence of post-implementation clinical feedback mechanisms are necessary conditions for algorithms not to amplify pre-existing inequalities. The question that arises is: do these conditions exist in the generality of Portuguese and European healthcare organisations? The available evidence suggests they do not, and that implementation systematically precedes equity impact assessment (European Commission, 2024).

2.3. The nurse in the algorithmic ecosystem: from periphery to centre

The literature on AI in health has privileged the medical and technological perspective, relegating nursing to a secondary role as a user of tools designed by others. This epistemological hierarchisation is, from an empirical standpoint, unjustified. Nurses are the professionals who spend the most time with patients, who continuously monitor their condition, and who, precisely for this reason, have access to a dimension of clinical reality that algorithmic systems simply do not capture: the lived experience, the behavioural nuances, the immediate social context (Economou-Zavlanos et al., 2025).

Cary et al. (2025), in the founding article of the BE FAIR framework (Bias Elimination for Fair and Responsible AI in Healthcare), published in the Journal of Nursing Scholarship, argue that nurses, by virtue of their proximity to patients and their identity as the most publicly trusted profession, are singularly positioned to address the challenges posed by the historical marginalisation of minority groups and the limitations of big data in healthcare contexts. The authors propose an action framework that articulates AI literacy competencies, advocacy mechanisms, and strategies for participation in algorithmic governance.

This position is reinforced by the European regulatory framework. Regulation (EU) 2024/1689, commonly referred to as the EU AI Act, entered into force in August 2024 and classifies AI systems used for medical purposes of diagnosis, monitoring, and prognosis as high-risk systems (high-risk AI systems). For these systems, the Regulation requires human oversight mechanisms, quality data governance, and documented transparency (European Parliament & Council of the European Union, 2024; European Commission, 2024). This requirement for human oversight does not designate only physicians or managers: it designates all healthcare professionals who interact with such systems in the course of their clinical activity, which includes, centrally, nurses.

3. Methodology

This article constitutes a theoretical analysis of a conceptual nature, developed through a narrative review of indexed scientific literature published between 2018 and 2025. The bibliographic search was conducted in the PubMed/MEDLINE, CINAHL, Scopus, and Web of Science databases, using the following combinations of terms in English and Portuguese: algorithmic bias nursing, clinical decision support equity, artificial intelligence health disparities, algorithmic fairness healthcare, nursing AI advocacy, and EU AI Act healthcare. Empirical articles, review articles, position papers, and regulatory documents directly relevant to the problem of algorithmic equity in clinical nursing were included.

Selection followed the criterion of conceptual relevance to the central argument, prioritising studies with verifiable empirical evidence and normative documents with legal validity. Data were analysed through inductive-deductive thematic analysis, identifying conceptual patterns around three axes: (1) mechanisms of algorithmic bias in health; (2) the nurse's epistemic position vis-à-vis clinical algorithms; and (3) organisational, educational, and regulatory conditions for the exercise of algorithmic advocacy. The construction of the theoretical framework followed the method of conceptual synthesis proposed for theoretical framing articles in the domain of nursing science, integrating theory, empirical evidence, and practical implications into an articulated model.

4. Theoretical analysis: the nurse as an agent of algorithmic equity

4.1. The nurse's singular epistemic position

Nursing occupies, in healthcare organisations, a position that has no equivalent in other professions. Whilst physicians interact with patients at punctual and decisive moments, nurses construct a relationship of continuity that allows them to access dimensions of the clinical and social condition that algorithms simply do not process: the fatigue that has been building since yesterday, the change in communication pattern, the detail that the patient did not mention to the physician but disclosed to the nurse who dressed their wound that morning. This *observational granularity*, to borrow a concept from data science, is irreplaceable and constitutes the substrate of a fundamental critical competency: the capacity to detect the divergence between what the algorithm recommends and what the patient's actual condition requires.

This capacity is neither intuitive nor automatic. It requires, on the one hand, sufficient solid clinical knowledge to recognise when an algorithmic recommendation is clinically and ethically questionable. It requires, on the other hand, sufficient digital literacy to understand the limitations of the systems being used, including the nature of the data on which they were trained and the populations they under-represent. It further requires an organisational context that values rather than silences well-founded challenge to automated recommendations, which implies genuinely rather than merely declaratively cultivated cultures of clinical safety (Ratwani et al., 2024).

The analysis of Economou-Zavlanos et al. (2025) of the *HUMAINE* curriculum (*Human-Centered Use of Multidisciplinary AI for Next-Gen Education and Research*) demonstrates that training nurses in *AI* competencies and bias mitigation is not only feasible but essential for ensuring equitable care. The authors identify as guiding principles of the curriculum transparency, accountability, safety, equity, and usability, acknowledging that a critical perspective on data-centric solutions must be combined with

action at the organisational, political, and social levels. This articulation between the technical and the ethical, between digital literacy and clinical advocacy, is the nucleus of what this article designates as *clinical algorithmic vigilance*.

4.2. A proposed theoretical framework: clinical algorithmic vigilance

Clinical algorithmic vigilance is defined in this article as the nurse's competency to critically monitor the recommendations of clinical *AI* systems, identify discrepancies between algorithmic suggestions and the patient's observed condition, and act in a well-founded manner when those discrepancies may reflect bias with an impact on equity of care. This is a second-order competency, which presupposes first-order technical competencies in digital literacy and clinical assessment, but which transcends them by introducing an explicit ethical and epistemological dimension.

The proposed theoretical framework articulates three interdependent dimensions:

Cognitive dimension: The nurse needs to understand the foundations of the algorithmic systems with which they interact: what type of data trained them, which populations they under-represent, what their objective function is, and by what metrics their performance is assessed. This understanding does not require programming training, but it requires what the literature designates as *AI literacy*: the capacity to critically read system documentation, to question its external validity, and to recognise the epistemological limitations inherent in any predictive model (Dornan, 2025; Cary et al., 2025).

Observational dimension: Sustained proximity to the patient grants the nurse access to clinical and contextual signals that algorithms do not process. *Clinical algorithmic vigilance* requires that this access be deliberately mobilised as an instance of verification of algorithmic recommendations. In practical terms, this means that the nurse develops a reflective practice of systematic contrast between the system's *output* and the direct clinical assessment, documenting identified discrepancies in a structured manner and communicating them to the relevant clinical governance bodies.

Advocacy dimension: Advocacy is a founding value of nursing ethics. In the algorithmic context, this advocacy acquires a new dimension: it is not merely a matter of defending the patient against a questionable human clinical decision, but of defending the patient against an algorithmic system that may be invisibly perpetuating inequality in access to appropriate care. The revised *Code of Ethics for Nurses* of the American Nurses Association (2025) explicitly recognises that nurses bear the responsibility of critically questioning the underlying assumptions of technological innovations, verifying whether these reflect the values, principles, and aims of the profession. This normative orientation grounds the advocacy dimension of *clinical algorithmic vigilance*.

4.3. Obstacles to the exercise of clinical algorithmic vigilance

The distance between the theoretical potential of the nurse's epistemic position and its effective exercise as an agent of algorithmic equity is determined by constraints operating at multiple levels. At the individual level, nurses generally possess limited *AI* literacy and data analysis skills, which restricts their capacity to offer well-founded challenge to the systems with which they interact (Wei et al., 2025). At the curricular level, pre- and post-graduate nursing education rarely includes modules dedicated to the critical evaluation of algorithmic systems or to the ethics of *AI* in health, treating digital technology as an instrumental domain rather than as a domain of knowledge with substantive ethical implications.

At the organisational level, feedback mechanisms concerning the performance of *AI* systems are frequently non-existent or difficult for direct care professionals to access. Ratwani et al. (2024), in an analysis published in *JAMA*, argue that local oversight of algorithmic systems in clinical contexts is an urgent regulatory necessity, but that its implementation requires organisational reporting and review structures that most institutions do not possess. Regulation (EU) 2024/1689 requires, for high-risk *AI* systems, human oversight mechanisms and post-implementation monitoring (European Commission,

2024), but the effective fulfilment of this requirement presupposes that healthcare organisations possess robust algorithmic governance systems and professionals qualified to operate them.

At the epistemic level, there is the further risk of what may be termed asymmetric deference: the tendency, documented in cognitive science and the safety of complex systems, for healthcare professionals to overvalue the recommendations of automated systems at the expense of their own clinical judgement. This deference is amplified in contexts of workload pressure, where the speed of the algorithmic response is perceived as an advantage rather than a risk. Alarm fatigue and temporal pressure therefore constitute systemic constraints that can transform a decision support tool into an invisible source of inequity.

4.4. Institutional conditions for the realisation of algorithmic equity

Clinical algorithmic vigilance cannot be an individual responsibility. Its realisation depends on institutional conditions that healthcare organisations, nursing schools, and regulators are obliged to create. Four fundamental conditions are identified:

First condition: *algorithmic literacy integrated into education*. Nursing curricula must include explicit training on the mechanisms of bias in *AI* systems, their implications for equity of care, and the strategies for detection and reporting. The aim is not to train programmers, but to train critical clinicians capable of questioning the systems with which they work. The *HUMAINE* framework (Economou-Zavlanos et al., 2025) offers a replicable model for the integration of this literacy into training programmes for nurse scientists and clinicians.

Second condition: *formal reporting and review mechanisms*. Healthcare organisations must create structured channels for nursing professionals to report clinically significant discrepancies between algorithmic recommendations and the findings of direct clinical assessment. These channels must be accompanied by systematic review processes and feedback mechanisms for the professionals who report. Only with this information circuit is it possible to identify patterns of bias with an impact on specific subpopulations.

Third condition: *nursing participation in algorithmic governance*. Clinical ethics committees, digital innovation working groups, and pre-implementation evaluation processes for *AI* systems must include nurses, not as consulted users, but as members with a deliberative voice. The knowledge nurses hold concerning vulnerable populations, patterns of differential access, and patterns of clinical variability is irreplaceable in the assessment of the adequacy and equity of algorithmic systems.

Fourth condition: *an organisational culture of psychological safety*. Well-founded contestation of an algorithmic recommendation requires that the professional who raises it feels safe to do so, without fear of institutional reprisals or of being perceived as resistant to innovation. A culture of psychological safety is a necessary condition for *clinical algorithmic vigilance*, given that its absence transforms algorithmic bias into an invisible problem: professionals detect it but do not report it.

5. Discussion

The findings of this theoretical analysis converge with the perspective of Cary et al. (2025) in positioning nurses as active agents of algorithmic equity, yet advance upon it by proposing a conceptual framework that articulates the cognitive, observational, and advocacy dimensions of this responsibility. Whilst the *BE FAIR* framework emphasises above all the elimination of bias as an ethical imperative, the notion of *clinical algorithmic vigilance* developed here focuses on the nurse's active role as a detector and communicator of bias in everyday clinical practice, which constitutes a distinct and complementary contribution.

In disagreement with the prevailing view in hospital management literature, which tends to frame nurses as technology users rather than governance agents, this article argues that the distinction between users

and governors of *AI* systems is conceptually inadequate and operationally dangerous in the context of health equity. The users of algorithmic systems are, in healthcare organisations, those who most directly observe their clinical effects and who, therefore, are best positioned to identify their points of failure. To disregard this position is, in essence, to squander the most valuable quality sensor that organisations possess.

The European regulatory framework, embodied in Regulation (EU) 2024/1689, offers, in this context, a historic opportunity. The classification of *AI* systems for medical purposes as high-risk systems, with requirements of human oversight and continuous monitoring, creates the legal foundation for nursing participation in algorithmic governance to cease to be a best-practice recommendation and to become a condition of regulatory compliance. This transformation of the status of human oversight, from an ethical recommendation to a legal obligation, is one of the most significant consequences of the *EU AI Act* for nursing, and has been insufficiently explored in the specialist literature.

The National Academy of Medicine (2024) underlined that *AI* systems have the potential to reduce health inequities when trained on diverse and representative data, but that this potential is only realised with active mechanisms of post-implementation surveillance and correction. Collectively, the available evidence underlines that algorithmic equity is not a state achieved at the moment of system development, but a continuous process of monitoring, evaluation, and adjustment that requires professionals deliberately prepared to engage in it.

6. Conclusion

6.1. Main conclusions

The analysis developed in this article demonstrated that nurses occupy, in the architecture of AI-mediated health systems, a singular epistemic position that renders them potentially decisive agents of algorithmic equity. This position is grounded in three structural characteristics: continuous observational proximity to the patient; the ethical identity of advocacy that defines the profession; and positioning at the clinical interface where the algorithmic *output* is, or is not adequately, translated into individualised care. Algorithmic bias in health is not a residual technical anomaly: it is a historical artefact of the structural inequalities that mark access to care, and its detection requires attentive observers positioned precisely where nurses are found.

6.2. Theoretical implications

The principal theoretical contribution of this article is the notion of *clinical algorithmic vigilance*, defined as the nurse's competency to critically monitor *AI*-based clinical decision support systems, identify discrepancies with an impact on equity, and act in a well-founded, advocacy-oriented manner. This concept articulates with the *BE FAIR* framework of Cary et al. (2025), with the analysis of Economou-Zavlanos et al. (2025) on *AI* training for nurse scientists, and with the requirement for human oversight enshrined in Regulation (EU) 2024/1689, constituting a conceptual framework with potential for integration in theoretical models of advanced nursing practice and clinical leadership.

In line with earlier findings on the position of nurses in health innovation processes (Dornan, 2025; Shepherd & McCarthy, 2025), the analysis developed here reinforces the perspective that nursing cannot be treated as a passive recipient of technological transformations, but as a discipline with the responsibility and epistemological resources to interrogate and reorient them when necessary. By contrast with approaches that frame algorithmic bias as a data engineering problem, the proposed conceptual framework situates it as a clinical governance problem, with direct implications for nursing theory and practice.

6.3. Practical implications

The practical implications of this article are organised at three levels. At the educational level, the integration of critical algorithmic literacy into undergraduate and postgraduate nursing curricula is proposed, with particular attention to bias mechanisms, their implications for equity, and the strategies for detection and reporting. At the organisational level, the creation of formal clinical feedback mechanisms concerning implemented AI systems is proposed, with structured nursing participation, together with the inclusion of these professionals in algorithmic governance committees. At the regulatory level, it is proposed that national health authorities, in the process of transposing and implementing the EU AI Act, explicitly recognise nurses as human oversight agents for the purposes of Regulation (EU) 2024/1689, which implies corresponding educational and institutional responsibilities.

6.4. Final considerations

Health equity is not a value that algorithms can guarantee autonomously. It is a responsibility that the people who use, oversee, and contest them exercise or neglect in every clinical encounter. Nurses are, by the very nature of their practice, present at that encounter. The question this article sought to answer is not whether nurses can be agents of algorithmic equity: the available evidence demonstrates that they can. The question is whether the conditions necessary for them to do so in a deliberate and well-founded manner exist. The current answer is, with intellectual honesty, negative. Building these conditions, at the curricular, organisational, and regulatory levels, is one of the most urgent and consequential tasks the nursing discipline faces in the coming decade.

Future research should examine, using mixed methodologies, the extent and nature of algorithmic bias in European and Portuguese clinical contexts, where population diversity and the specific characteristics of the health system pose challenges distinct from those predominantly studied in the North American literature. It should equally evaluate the effectiveness of educational interventions grounded in the conceptual framework proposed here, contributing to the accumulation of evidence on the conditions for the realisation of *clinical algorithmic vigilance* in practice.

Unlike an algorithm, which has no awareness of its own injustice, a nurse does, and it is precisely this irreducible difference that makes algorithmic equity ultimately dependent on nursing.

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