Towards an ethical governance framework for artificial intelligence in healthcare in Morocco: Needs analysis and structured proposal

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Abstract

Artificial intelligence (AI) is revolutionising healthcare worldwide, with potential benefits to enhance care. Nevertheless, its application also entails significant ethical issues, in determining algorithmic bias and related discrimination, ensuring privacy protection with respect to personal data management and enforcement. In Morocco, where digitalization of the health system is implemented despite the lack of regulatory provisions, this article suggests appropriate ethical and operational governance.

Our approach is based on a comparative analysis between WHO, European Union dimensions and and considers national specificities. We introduce a model built on four interrelated pillars: A) regulatory provision with national ethic committee, B) technical receipt for algorithm validation, C) institutionalisation of clinical practice (including professional training), D) rapid-learning health system after implementation.

It is this twin concern for both innovation and protection of the patient that the new vision on AI intends to consider in order to ensure that AI can be at the service of the Moroccan population. The suggested framework offers a useful guidance for policy makers and health care actors and situates Morocco as a responsible player in the process of implementing new medical technologies. It will be brought into effect through a partnership of state process, health care provider participation and civic society involvement.

Keywords: Artificial Intelligence, Ethics, Governance, Digital Health, Morocco, Regulatory Framework.

1. Introduction

AI is transforming the world's healthcare. Its use, from diagnosis in medical imaging to drug discovery, personalized medicine or optimization of hospital management, could lead to more efficient, accurate and accessible health care [1]. Machine learning, and especially deep learning, can help facing new unprecedented scale in health data with the opportunity to reveal such subtle patterns that is beyond human expert analysis [2]. So this digital revolution not just is going to be happening

and oh it's pending, but everything is being true – I mean coming true – for developed countries and poor countries as well.

But as that promise is being fulfilled, the technology also poses serious ethical and societal concerns. A computer monitor, on which A cycle of elements such as graphs and waves are shown from the left to right To the reverse upper, in turn a sequence of text labels are inscribed: "The Left Right Appro-DOMAINS includes Algorithmic biases that may serve to perpetuate or exacerbate social inequalities in health 141/ −52, Respect for privacy and confidentiality of Patient data 133/ The opacity which characterises black-box Model decisions contests liability on error119[3], [4]. But, as the World Health Organization has warned, "AI. is a powerful asset but there must be ethical application of it to safeguard the individual and community" [5]. In this sense, Morocco is more of an opportunity and a risk than anywhere else. The Kingdom has committed to a colossal digitization effort for its healthcare system in order to enable access and quality of care—similar to telemedicine and shared medical records. Although there are some AI related projects, others don't have a specific governance to address the ethical implications of using AI in healthcare. This "regulatory gap" poses a legitimate risk: powerful technologies are brought to use in ways that lack sufficient protections for patient safety, system fairness, and trust in the public [6].

In response to these dilemma, the international community has released several ethical frameworks. The European AI Regulation (AI Act[1]) is risk-based in nature, and therefore introduces strict requirements for high-risk AI systems which are also employed in healthcare. The WHO has itself released six ethical AI principles for use in health care, such as safeguarding human autonomy, supporting well-being and safety, and assuring transparency [5]. Other proposals, for example the Montreal Principles[2] and the Future of Life Institute[3] guidelines, stress fairness, non-malevolence and accountability.

However, as Jobin et al. (2019) argue in their extensive report on AI ethics principles, there is a thin "veneer of agreement at the level of abstract principles," but disagreement at the level of interpretation and, more importantly, their practical application [7]. The review highlights a conspicuous dearth in literature on the operationalization of these principles within specific national contexts, especially in middle income countries like Morocco with its own challenges for infrastructure, technical capabilities and socio cultural conditions.

In this sense, the primary aim of this article is to present an ethical governance framework (EGF) for the AI in healthcare field developed with modified versions of existing guidelines, and conceived to be flexible and manageable for Moroccan implementation.

The secondary objectives are as follows:

1. To identify and justify the most relevant fundamental ethical principles to guide the deployment of AI in the Moroccan healthcare system.

2. Analyze the strengths and limitations of international regulatory frameworks in order to draw lessons applicable to Morocco.
3. Propose an operational governance architecture, defining the key actors, processes, and oversight mechanisms necessary for its effective implementation.

2. Methods (Methodology)

2.1. Study design

The present study is, at this point, an exploratory research with qualitative approach. The objective is to collect and place developed insights in a broader movement towards the conceptualisation of model governance. The methodology is based on narrative literature review and comparison perspective with other regulatory frames as well as context analysis including Moroccan features. For a new field"s inquiry and for evidence-based policy recommendations, this is a reasonable strategy.

2.2. Data collection

Literature review Data was collected through a comprehensive and systematic literature search made between January-March 2024. The sources referenced fall into several categories:

- **Scientific literature:** A review was performed to find the appropriate published literature in PubMed, Google Scholar, Scopus electronic devices.
- **Google Scholar, and Scopus** electronic databases to identify relevant published articles.
- **Official documents and "gray literature":** Reports of the international organizations (WHO, World Bank), regulatory texts (European AI Regulation - AI Act, guidelines from Health Canada) and national strategic documents (Law 06-22 related to digitization of the healthcare system, Law No. 09-08 on the protection of individuals in relation to the processing of personal data).
- **Search keywords:** Queries were constructed as follows: "AI governance AND healthcare AND ethics AND regulatory framework AND Morocco AND global health and algorithmic bias OR medical device regulation.

2.3. Analysis method

The data obtained were evaluated by a three-step process:

1. **Comparative analysis of international frameworks:** A systematic comparison was carried out with a set of key international frameworks (EU AI Regulation, WHO principles, and Montreal guidelines). The emphasis of these examinations were on the fundamental elements of medical ethics, methodological and procedural standards as well as a realization and supervision. [5] The hope was to find best practices and elements that could replicated.
2. **Contextual analysis of the Moroccan landscape:** we sought to adjust the general principles to the

Moroccan landscape. This analysis examined:

- The **existing legal and regulatory framework** (data protection act, the code of medical ethics) [8, 9].
- The **digital maturity of the healthcare system** and infrastructure capabilities.
- **Socio-cultural factors**, such as linguistic (Arabic / Amazigh speakers) and digital literacy.
- **Specific challenges** in terms of access to care and equity.

3. **Synthesis and modeling:** The next step was to integrate the results of comparative and contextual analysis into our proposed governance model: third stage. This synthesis guided our construction of a systematic and multi-faceted framework (the four pillars) in which each component has to respond to an ethical requirement formulated in the literature, but also to a limit or resource related to the context Morocco.

The following table summarizes the methodological approach used:

Table 1: Methodological framework of the study

Stages	**Analytical objective**	**Sources consulted**	**Data collected**	**Data processing**
Comparative analysis of international frameworks	Identify best practices and transferable elements	Regulatory texts (EU AI Act), WHO reports [5], international ethical guidelines	Ethical principles, implementation mechanisms, technical requirements	Thematic analysis and systematic comparison of mechanisms
Contextual analysis of Morocco	Adapt general principles to national realities	National laws [8], Government strategies, Local academic publications, Demographic data	Existing legal framework, digital maturity, cultural specificities, infrastructure capacities	Assessment of regulatory gaps and SWOT analysis
Synthesis and modeling	Develop a coherent and appropriate governance architecture	Scientific journals [10-11], Conceptual frameworks, Similar case	Governance models, monitoring mechanisms, organizational	Systemic integration and adaptive modeling

		studies	structures	

3. Results / Proposai for an ethical governance framework for AI in healthcare in Morocco

Our comparative and contextual analysis allows us to propose a governance framework structured around two essential foundations: a series of fundamental ethical principles and an operational architecture based on four interdependent pillars.

3.1. Fundamental ethical principles for Morocco

Our synthesis of international frameworks has led us to identify six fundamental principles that are tailored to the priorities of the Moroccan healthcare system:

1. **Beneficence and non-maleficence:** AI systems must be designed and deployed with the primary goal of improving patient health and well-being. A rigorous assessment of risks (both medical and psychosocial) is imperative before any implementation [5, 10].
2. **Human autonomy and informed consent:** It is essential that clinical judgment and patient autonomy be supported by AI, not replaced. 2001) and specific informed consent (informing about the role of AI in decision-making) is needed [11].
3. **Justice and fairness:** Particular care should be taken to avoid algorithmic bias. Training datasets should represent the diversity of the Moroccan population in order to prevent further any existing inequities towards access or quality of care [3, 11].
4. **Transparency and explainability:** the "black box" in medicine is no longer acceptable. It is imperative to also advance the field of “explainable” AI (XAI) [4], and demand clear documentation of how algorithms work as well as what they are unable to do for practitioners.
5. **Robustness, safety, and performance:** AI technology should be robust and resilient to the conditions encountered in healthcare. Their utility also needs to be constantly verified under the actual conditions of use in Morocco.
6. **Human oversight and accountability:** Meaningful human control must be maintained throughout the AI lifecycle. The chain of accountability (prescribing physician, healthcare facility, developer) must be clearly defined within the Moroccan legal framework.

3.2. The proposed four-pillar governance framework

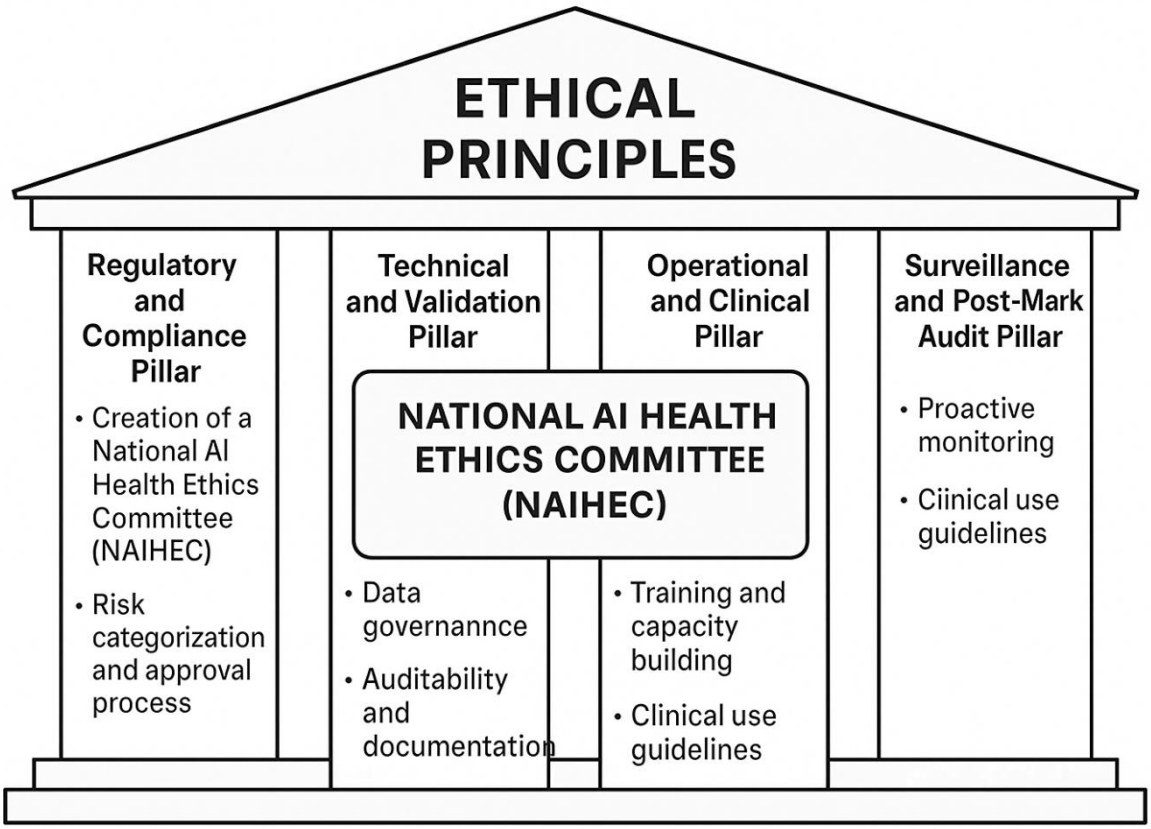
An SWOT analysis (Table 2), summarizing the strengths, weaknesses, opportunities and threats that affect its design was performed prior to describing how the framework should be structured. Such strategic al analysis guarantees that the introduction of the framework is not only ethically grounded but also plausible and sensitive to local on-theground needs in Morocco.

Table 2: SWOT analysis of the Moroccan context for the implementation of an AI governance framework in healthcare

Internal Factors (Controllable)	External Factors (Uncontrollable)
Strengths • Law 06-22 encouraging the digitization of healthcare • Existence of Law 09-08 on data protection • Existing regulatory structure (ANAM) • Skilled diaspora	**Opportunities** • Possibility of drawing inspiration from international frameworks • Growth of the Moroccan tech ecosystem • Investor interest in healthtech • Young population and adoption of digital technology
Weaknesses • Lack of a specific framework for AI • Lack of local expertise in AI ethics • Uneven technological infrastructure • Weak data science culture among healthcare professionals	**Threats** • Risk of uncontrolled deployment of solutions • Technological dependence on foreign countries • Digital divide that could amplify inequalities • Commercial pressure from international companies

Based on this analysis, the following governance framework is proposed, structured around four interdependent pillars designed to capitalize on strengths and opportunities while mitigating weaknesses and threats. The overall architecture is illustrated in Figure 1.

Figure 1: Architecture of the proposed governance framework for AI in healthcare in Morocco



This is followed by the system architecture of the proposed governance framework. It is organized based on four building blocks: Regulatory, Technical, Operational and Oversight that act synergistically to promote and make operational the core ethical principles. These elements are articulated and convergent around which supports the action of Central National Ethical Committee AI in Health (CNE-CIA-S), witnessing for coherence, coherence and synergy global. It is the implementation of a national vision illustrated with a strategic SWOT analysis related to the Moroccan environment. Each pillar is detailed below:

Pillar 1: Regulatory and Compliance Pillar: This pillar establishes the legal and institutional foundation:

Création of a National Ethics Committee for AI in Healthcare (CNE-IA-S): We propose the creation of an independent, multidisciplinary body under the aegis of the Ministry of Health. Its composition would include clinicians, AI researchers, specialized lawyers, ethicists, patient representatives, and data protection authorities. The CNE-IA-S would have the following missions:

- to issue opinions on AI projects;
- validating risk assessment methodologies;
- and (3) to serve as an observatory of best practices [5, 12].

The creation of a National Ethics Committee for AI in Healthcare (CNE-IA-S) directly addresses the weakness (lack of expertise) by creating a dedicated center of expertise, and builds on an existing strength (the ambition and desire to digitize the healthcare sector) to fit into an overall vision.

Risk categorization and approval process: Derived from the European AI Act a thresh system is derived for classifying AI applications in healthcare according to their risk. High-risk systems (e.g., support for diagnosis of cancer, supports in intensive care) have to be certified before being deployed and used (but without mandatory certification the threshold should not be too high and build on as we suggested above ethical principles of practice and safety standard – enforcing authority can also concerns ANDAM or ANAM new mission).

Pillar 2: The Technical and Validation Pillar: This support covers the needs for [the design] and validation of technologies.

Data governance: It is of crucial importance to enact strict guidelines on health data collection, anonymization and use in full accordance with Law 09-08. The building of national and representative Moroccan data lake respectful of privacy, is a necessary condition to promote equitable AI [8, 11].

Auditability and documentation: independent Auditing: Developers will create a test protocol and finish reading/write on their product. As these activities are ongoing, interoperability standard should be followed to facilitate linkage with the National health Information System (e.g. HL7 FHIR).

The data governance norms also seek to preserve the resilience of Law 09-08 and an effort is being

made to counterbalance technological reliance through an open, interoperable standard obligation.

Pillar 3: The Operational and Clinical Pillar: This pillar focuses on integration into daily practice.

Training and capacity building: A national training program for healthcare professionals needs to be established in order to sensitize them towards the ethical considerations related to AI and to train these professionals on how to interpret and use such tools critically [13].

The training arm tackles the fragility of the data science ecosystem; due to lack of culture, and take advantage of a young population by developing local capacity.

Guidelines for clinical use: While clinical protocols need to be modified, it is important that AI has a well-defined place in the care pathway with an emphasis on decision support. An AI specific model consent form should be created and commonly employed [11].

Pillar 4: Post-Market Surveillance and Audit Pillar: This pillar ensures ongoing vigilance after deployment.

Proactive vigilance: A pharmacovigilance-like system should be organized for AI. Healthcare facilities and providers should be mandated to report any real-world mispecifications or bias detected [14].

Periodic audits: The performance and side-effects of AIs approved by CNE-IA-S should be followed over time to make sure they work well and are not harmful.

That will be addressed squarely in this column, though by the method of facilitating runaway introduction of experimental interventions.

And this is cleverly articulated on these four fronts that are organically worked out from that strategic logic together with national narrative this very much needsmelting government too. This framework has the objective to make Morocco a peaceful user of AI for health therefore, it could benefit from innovations and ensure that patient's safety and equity in health system. Realisation of such a system, however, relies on both cross-sectoral action and political commitment as described in more detail below.

4. Discussion

This is the first AI ethics steering framework related to health in Morocco. Our study highlights a critical regulatory blind spot, and actions that are urgently required to regulate the use of technologies like these for maximum benefit and minimum harm.

4.1. Interpretation of key findings

The four-pillar structure we propose aims to create a virtuous and resilient ecosystem. By placing **Ethical principles** at the basis of the structure, we highlight that technology has to serve basic human values. The establishment of the National Committee (CNE-IA-S), at the core of our proposed system, meets directly with this need for specialized and multidisciplinary supervision, one of the main learned

lessons from analysis on international models [5] [12]. Our strategy is not to copy-paste the European Regulation, but implement it with pragmatism. With the proposal to extend ANAM's certification mandate, we are suggesting a viable solution that uses an institution already in existence, which makes it more feasible.

Strengths and originality of the proposed framework

The key benefit of this framework is its ability to adapt to context. Unlike passively adapting foreign models, this model is consciously adapted to Moroccan specificities:

- **Relevance in the face of bias:** Data representativeness and fairness where stressed as a necessity in response to the threat that algorithms trained on foreign data might work less effectively for Moroccan context, contributing to increase in inequalities.
- **Institutional pragmatism:** the proposal to take existing work (ANAM, Law 09-08) as a springboard indicates awareness of administrative and legal realities for faster pick-up [8].
- **Holistic approach:** The focus is not just on regulatory pressures, but across all fronts. Made up of technical, operational and oversight measures, it recognises there is no such thing as a check-box upstream, that AI ethics is not just something you do in the design phase before deployment – rather an ongoing process from development to real-world usage.

4.2. Limitations and implementation challenges

It is crucial to recognize the limitations of this work and the challenges to be overcome.

- **Nature of the study:** The study that has been done is a conceptual proposal. It would need to undergo validation with formal stakeholder consultation (Delphi methods/consensus workshops) to develop operational parameters and establish acceptability [15].
- **Practical challenges:**
    - **Funding and expertise:** The establishment and running of the CNE-IA-S, including a good auditing system will cost money; to have specialized people at hand is not always available in the beginning.
    - **Resistance to change:** The introduction of AI in everyday clinical practice will face cultural and professional resistances that have to be managed potentially by continuous training and communication [13].

    Legal challenges: Our framework proceeds from existing laws, aiming to highlight a framework law on AI in healthcare that can consolidate all its pillars and strengthen the legal enforceability.

4.3. Implications and recommendations

To get out of the theory, in practice we recommend the next:

1. **For policymakers (Ministry of Health, government):** Start national dialogue on AI in health now. One such priority would be to commission a study group that outlines the road map for establishment of CNE-IA-S and proposals/opinions as to its possible expansion in terms of granting responsibilities for ANAM.
2. **For healthcare institutions and universities:** Create continuing education courses on digital literacy and AI ethics for medical professionals. University hospital centers (CHU) should be front runners in developing so-called "living labs" where AI applications can be tested and assessed within a controlled environment.
3. **For future research:** Studies should be conducted as a priority to:

(a) map and evaluate the level of health data in Morocco for algorithms.

(b) establish and validate models of informed consent based on Moroccan culture;

and c) evaluate the cost-effectiveness of implementing AI in healthcare.

5. Conclusion

Incorporating artificial intelligence in the Moroccan health care is a must, no more an if but a how. Since just such evolution is inevitable, regulatory non-involvement is not a choice. This article clearly underlies the defined lack of a framework dedicated to governance, in Morocco, facing the rapid evolution of technologies that risks endangering patients and the integrity of healthcare system.

To fill this gap, we suggest a comprehensive ethical governance framework for the national level. We have grounded our approach in six core ethical principles and constructed a governance structure that closely marries four inter-related pillars: regulatory, technical, operational, oversight. We present a road map on how to implement responsible AI. The backbone of this proposition is to create a National Committee on Ethic and AI applied to Health (CNE-IA-S) as a key multi-member professional diverse in its composition, as an orientation and supervisory audited body over these technologies deployment.

Such a programme is possible only with strong political commitment, investment in human and technical capacity, and trust of all parties. It's a must as an ENTERPRISE towards the future of Morrocan Healthcare. If the Kingdom plays it right, wisely and ethically, its strategy will see the kingdom transform itself not just a consumer but an informed shaper of AI in healthcare – with technological advances benefitting one and all alike.

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