The Absence of Institutional Ethics in Intelligent Public Health Governance and Its Reconstruction: A Normative Analysis Based on Value Sensitive Design

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Abstract This paper introduces value sensitive design (VSD) and institutional ethics theory, proposes a diagnostic framework of "institutional ethics absence", and differentiates between the two paradigms of "technical ethics embedding" and "institutional ethics reconstruction". The analysis indicates that the prevailing ethical challenges in the intelligent public health governance do not stem from technical limitations. Instead, they reflect an external manifestation of the absence of institutional ethics. Although ethical principles are broadly proclaimed, there is a deficiency in operational mechanisms to transform these principles into institutional regulations, leading to "institutional hollowness" wherein principles exist nominally but lack substantive enforcement. The article elucidates the integration pathway between VSD and institutional ethics: VSD offers a methodological foundation for embedding ethical considerations into design, whereas institutional ethics provides a "meta-institutional" guarantee for the design process. Together, these approaches facilitate the "dual embedding" of ethical requirements at both technological and institutional levels. This paper develops a three-tiered institutional reconstruction pathway centered on the core concepts of "precaution, human subjectivity, and justice". It integrates the frameworks of technical standard setting, organizational ethics review, and legal accountability, thereby offering theoretical support for the ethical legitimacy of intelligent public health governance in the digital era.

Key words Intelligent public health governance, Institutional ethics, Value sensitive design (VSD), Algorithmic ethics, Health equity, Ethical institutionalization

1 Introduction

The profound embedding of artificial intelligence within the domain of public health governance has resulted in substantial improvements in efficiency across areas including disease prediction, resource allocation, and epidemiological surveillance. Nevertheless, alongside these efficiency gains, there has been a notable increase in incidents of ethical misconduct. Obermeyer *et al.* [1] demonstrated that the health management algorithm widely utilized by Optum (USA) systematically underestimated the medical needs of black patients. Under equivalent conditions, the proportion of black patients receiving prioritized care decreased significantly to 17.7%. Furthermore, the World Health Organization (WHO) has identified algorithmic bias, privacy violations, and ambiguous responsibility as systemic risks linked to the application of artificial intelligence in global public health[2]. The widespread adoption of intelligent diagnosis and treatment systems in China also raises concerns regarding algorithmic fairness and issues related to the evasion of responsibility[3-4]. These challenges are not merely technical flaws but instead reflect underlying imbalances in institutional arrangement.

Scholars in China have conducted multifaceted discussions on this subject. Zhang Shuyan *et al.* [3] advocated for preventing discrimination through algorithmic transparency; Tong Yuanyuan *et al.* [5] proposed mitigating bias by enhancing data diversity and implementing algorithmic reviews; Xu Zhuoyu *et al.* [4] examined risk prevention from the perspective of the rule of law. However, the majority of existing research continues to concentrate on technical patches or ethical checklists, and has not adequately addressed the institutional foundations underlying the recurrent failures of ethical value.

This article posits that the core issues underlying algorithmic discrimination, privacy crises, and ambiguous responsibilities stem from a systematic absence of institutional ethics. This absence is not due to a lack of ethical principles but rather the deficiency of operational mechanisms to translate these principles into institutional regulations. Building on this perspective, the paper integrates value sensitive design (VSD) with institutional ethics theory and proposes a three-tiered pathway for institutional reconstruction. The core innovation resides in differentiating between two paradigms: "technical ethics embedding", which involves integrating ethical considerations into algorithm design and pertains to technical optimization; and the "reconstruction of institutional ethics", which addresses questions regarding the enforcement of embedded compliance and the resolution of value conflicts, thereby relating to institutional development. The exclusive focus on technology embedding, without concurrent institutional reconstruction, renders it challenging to fundamentally resolve ethical dilemmas.

2 The absence of institutional ethics: diagnosis of the "normative deficit" in the intelligent public health governance

2.1 Algorithmic discrimination: The illusion of technological neutrality and the production of institutional bias The essence of algorithmic discrimination should not be ascribed to tech-

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nical faults; instead, it constitutes a manifestation of institutional bias embedded within production processes. Obermeyer *et al.*[1] demonstrated that the Optum algorithm employs medical expenditures as a proxy for health needs, resulting in the systematic "underestimation of risk" among black patients. Despite exhibiting equivalent risk scores, these patients present with more severe health conditions (specifically, 26.3% more chronic diseases) yet they receive comparatively less medical care. Benjamin[6] highlighted that so-called "race-blind" algorithms perpetuate structural racism by relying on alternative variables. Building on this insight, the present article differentiates between "data bias" (technical flaws in training data) and "institutional bias" (reproduction of social inequalities through algorithmic rules)[7]. Even when race is not explicitly included as a variable, existing inequalities are encoded into the algorithm's "objective" judgments via proxy variables. Based on this, the concept of "institutionalized bias production" is introduced: algorithmic discrimination transforms inequality from a mere factual condition into an institutionalized arrangement, thereby acquiring legitimacy through data-driven processes. From the standpoint of medical philosophy, this phenomenon directly contravenes the principles of justice and non-maleficence as articulated by Beauchamp and Childress[8]. Importantly, this violation does not arise from individual immorality but rather represents a collective outcome resulting from failures in institutional design.

2.2 Privacy crisis: failure of informed consent in the digital age The conventional informed consent system is predicated on the premise of "individual rational decision-making". However, this premise has been fundamentally challenged within the realm of public health big data. The magnitude of health data collection and the rapidity of its dissemination surpass individuals' cognitive capacities. Consequently, informed consent is diminishing from a substantive protective right to a mere procedural formality[9]. This article posits that the essence of the privacy crisis resides in the absence of an adequate system; specifically, the existing system lacks ethical norms concerning the power relations of health data and the scopes on third-party usage. Nissenbaum's "contextual integrity" theory offers a crucial analytical framework, asserting that privacy violations occur when the flow of information contravenes the norms of a particular social context, rather than mere information leakage[10-11]. Based on this premise, the article advocates for transforming the principle of "patient autonomy" from a static, "one-time authorization" to a dynamic, "contextualized consent" model[12]. However, this reconstruction remains insufficient, as the uncertainty of responsibility attribution further undermines patients' ability to seek redress when algorithmic decisions result in harm.

2.3 Ambiguous responsibility: the "responsibility gap" in distributed intelligent systems Algorithm-driven public health decision-making encompasses multiple stakeholders, including data providers, developers, public health institutions, and clinical users. The principle of "responsible parties" in traditional tort law faces challenges in appropriately positioning predicament[13]. This article differentiates between two types of diagnostic challenges: the "difficulty in attributing responsibility", which constitutes an epistemological problem, and the "lack of responsibility system", which represents an institutional ethics issue[14]. The central focus is on developing a responsibility allocation system that aligns with the specific characteristics of intelligent governance. The concept of the "responsibility gap", as proposed by Matthias[13], highlights that when the behavior of learning automata surpasses the foreseeable range, traditional strategies for attributing responsibility tend to be ineffective. Floridi's[15] theory of "distributed moral responsibility" emphasizes that moral evaluation arises from the interaction among multiple sources of action. Building on this foundation, the present paper introduces the concept of "responsibility allocation matrix". This matrix involves determining the standard of duty of care in accordance with the level of algorithmic autonomy, tracing the chain of responsibility based on the link at which damage occurs, and establishing a joint liability mechanism among developers, deployment institutions, and users[16]. At this stage, the reconstruction of institutional ethics transitions from diagnosis to response.

3 From principle impact to theoretical response: the emergence logic of institutional ethics

3.1 Impact mechanism of intelligent technology on the core principles of traditional administrative ethics The influence of intelligent technology on the ethics of public health governance reveals a structural systemic tension. Jobin *et al.*[17] analyzed 84 global AI ethics guidelines and identified transparency, accountability, fairness, and autonomy as the central principles reflecting cross-cultural consensus. However, the principle of transparency faces challenges due to the algorithmic black box, wherein the decision-making process is difficult to trace. The principle of accountability is complicated by the ambiguous division of labor between humans and machines, resulting in a disruption of the "behavioral-subject-consequence" chain. Furthermore, the principle of fairness is undermined by biases present in historical data, as "neutral computation" tends to replicate institutional discrimination[18]. Lastly, the principle of autonomy has been supplanted by automated decision-making, leading to professional autonomy being reduced to a passive endorsement of algorithmic outputs[16]. The four impacts share a fundamental structure characterized by the "implicit replacement" of ethical principles with technological rationality. This article conceptualizes this phenomenon as "institutional hollowness", wherein principles exist in form but lack substantive constraints (Table 1).

This diagnosis presents a theoretical opportunity to transition from principled discourse to an analysis of institutional ethics.

3.2 Limitations of technological ethics pathway: from "value alignment" to "institutional hollowness" Although technical solutions such as explainable AI, federated learning, and fairness algorithms possess significant value, they exhibit inherent structural limitations[19]. The limitations of this approach stem from

Table 1 Impact mechanism of intelligent technology on the four ethical principles and institutional ethical diagnosis

Ethical principle	Mode of technological impact	Institutional ethics diagnosis
Transparency	The black box of algorithms renders the decision-making process untraceable	Transparent in form but concealed in essence
Accountability	The ambiguity surrounding the division of labor between humans and machines has resulted in a lack of clarity regarding the responsible entities	Break in the chain of responsibility
Fairness	Historical data bias is exacerbated by algorithmic processes	Procedural neutrality, biased outcomes
Autonomy	Automated decision-making systems supplant human judgment	Selecting an architecture preset, autonomy in name only

three primary flaws: first, the ambiguity regarding the source of value—specifically, who defines "fairness" and by which standards it is measured—cannot be resolved solely through algorithmic design[18]; second, an excessive reliance on developers' ethical awareness, as public ethical assurances depend on private virtues, making sustained reliability challenging[15]; and third, an inability to address power asymmetries, since when prejudice originates from historical inequalities, technological patches fail to touch the underlying institutional causes[16]. This article summarizes the phenomenon as the "ethical technologization trap", wherein complex ethical issues at the institutional level are reduced to optimization problems at the technical level. When "fairness" is operationalized through statistical indicators and "accountability" is reduced to model audits, fundamental questions are overlooked: who determines value, by what processes, and how is its implementation ensured? The limitations of technical ethics create an opportunity for the development of institutional ethics.

3.3 Introduction of institutional ethics: an integrated framework as the normative foundation Fang Jun[20] pointed out that institutional ethics encompasses two dimensions: "the ethics of institutions", which involves the moral evaluation of the institutions themselves, and "ethics within institutions", referring to the value norms inherent in these institutions. Gao Zhaoming[21] further asserted that the core of institutional ethics lies in the equitable arrangement of rights and obligations. Building on these perspectives, this article defines institutional ethics as the institution itself serving as the object and carrier of ethical evaluation. It is essential to distinguish among three levels of ethics: institutional ethics, individual professional ethics, and applied ethics. Institutional ethics differs from individual professional ethics in that, despite the good intentions of individuals, flawed institutions can systematically produce unethical outcomes[20]. Furthermore, institutional ethics is distinct from applied ethics; while applied ethics involves the application of ethical principles to individual cases, institutional ethics subjects the institution itself to ethical review[21]. This article puts forward three fundamental components of institutional ethics: the moral legitimacy of rules, the justice of procedures, and the accountability of systems. Intelligent governance should not be understood merely as the application of neutral tools; rather, it constitutes a novel form of institutional practice. Algorithmic systems, by reconfiguring information and power, fundamentally reconstruct the institutional structure of governance. Consequently, ethical review must extend to the institutional level.

4 VSD meets institutional ethics: a dual argument for the "institutionalization" of ethics

4.1 Contribution and boundaries of VSD The core proposition of VSD is the systematic integration of human values throughout the entire lifecycle of technical design[22-23]. Friedman and Hendry[24] further elevated this concept to the level of "moral imagination". However, VSD presents certain limitations that warrant consideration. Manders-Huits[25] has critiqued the absence of an adjudication mechanism when there are value conflicts, while Borning and Muller[26] have emphasized the necessity of contextualizing VSD's assertion of "universal values". This paper contends that its primary limitations can be encapsulated in three key shortcomings: it does not address who is responsible for constructing the institutional adjudication mechanism in cases of value conflict; it overlooks how organizational systems beyond design behavior embody ethical requirements; and it fails to explain the factors that drive institutional change. The fundamental distinction proposed herein is that VSD pursues "ethics in design", whereas this article advocates for an "institutional ethics of design". Specifically, VSD necessitates institutional ethics to offer "meta-institutional" guarantees, which regulate design behaviors and resolve value conflicts. While VSD presupposes the presence of "virtuous designers", it does not address the systems that should be in place when designers fail to act ethically.

4.2 Deepening of institutional ethics theory: from "embedded design" to "embedded institutions" This article advances a central proposition: the implementation of ethical requirements should extend beyond the mere embedding within technology and must be further integrated into systemic frameworks. Van de Poel[27] emphasizes that embedding values into AI systems is not solely a technical endeavor but also a social practice situated within a specific institutional context. In the absence of ethical constraints within the institutional environment, value design may degenerate into a rhetorical instrument that legitimizes technology. The primary cause of numerous public health AI ethics scandals is not inherent design flaws but rather the institutional absence. The case of IBM Watson for Oncology demonstrates that the central issue is not the algorithmic design itself, but the lack of ethical evaluation during the procurement process and the absence of ongoing oversight throughout its operation. These cases demonstrate that ethical design without institutional embedding functions merely as an "ornamental aspect" of technical systems. Conversely, institutional design lacking ethical guidance serves only as a "legitimizing façade" for the will to power. Based on the foregoing, this paper proposes a three-tier model for the "institutionalization"

of ethics: (i) the technical standards layer, which translates ethical requirements into measurable indicators and standards for algorithm evaluation; (ii) the organizational process layer, which integrates ethical review procedures throughout the entire lifecycle of AI systems; and (iii) the legal and regulatory layer, which elevates ethical requirements to legally binding norms. These three layers represent a continuum progressing from flexible to more stringent mechanisms.

4.3 Urgency and feasibility of ethical requirements for "institutionalization" The governance of AI in global public health is presently at a pivotal window period: although ethical principles have gained widespread recognition[17], they have not yet been formalized into binding institutional regulations[28]. Failure to achieve this transformation within the current window period may result in the dilution of ethical consensus owing to the absence of institutional carriers. The converse of urgency is feasibility. At the international level, the EU AI Act implements a risk classification framework, categorizing medical AI as a "high-risk" domain[29]. The WHO[2] has proposed six fundamental ethical principles and recommended the establishment of a multi-tiered governance structure. At the domestic level, the algorithm filing system introduced in the *Interim Measures for the Administration of Generative Artificial Intelligence Services*[30] represents an initial step toward institutionalizing transparency. The *Measures for the Review of Science and Technology Ethics (Trial)*[31] have established an ethical review framework at the organizational process level. Furthermore, the *Opinions on Strengthening the Governance of Science and Technology Ethics*[32] explicitly advocate for the elevation of ethical norms to the status of laws and regulations. However, the aforementioned explorations remain in their "nascent institutional stages"—dispersed across various normative levels and lacking systematic integration. The "institutionalization" of ethical requirements entails a comprehensive reconstruction across three levels, aiming to establish these ethical requirements as constitutive rules within technical standards, organizational processes, and legal frameworks.

5 Reconstruction pathways of institutional ethics: concepts, dimensions and mechanisms

5.1 Core concepts: precaution, human subjectivity, and justice The reconstruction of institutional ethics necessitates the establishment of a dominant value coordinate. This article identifies precaution, human subjectivity, and justice as its core principles, each addressing specific institutional challenges posed by algorithmic discrimination, privacy crises, and ambiguous responsibility, respectively. These principles are not merely abstract, parallel slogans; rather, they serve as essential criteria for guiding the intelligent governance of public health, facilitating a shift from "prioritizing efficiency" to "upholding ethical defensibility".

5.2 Technical standard level: traceable, interpretable, and appealable ethical embedding Value concepts should be transformed into operational norms via technical standards. This article proposes a three-dimensional framework for technical ethics standards characterized by "traceability, interpretability, and appealability", aiming to integrate abstract ethical principles into the design, operation, and error correction processes of intelligent public health systems.

5.3 Organizational process level: ethical pre-review, multidimensional accountability, and resilient supervision The implementation of technical standards relies on the systematic reengineering of organizational processes. In the absence of stable organizational procedures, traceability, interpretability, and appealability tend to remain confined to technology list and are challenging to transform into enforceable constraints. Therefore, the reconstruction of organizational processes for intelligent public health governance should emphasize ethical pre-review, multidimensional accountability, and resilient supervision.

5.4 Legal and regulatory level: from principle declaration to enforceability rules The majority of existing norms are primarily advocacy statements. Although the *Interim Measures for the Administration of Generative Artificial Intelligence Services*[30] propose the requirement of "respecting ethics and morality", they lack precise legal definitions for specific behaviors, such as algorithmic discrimination. Similarly, the *Ethical Code for the New Generation of Artificial Intelligence*[33] primarily adopt an advocacy-based approach. This reliance on "soft law" makes it challenging to establish effective regulatory constraints. In response, this article proposes three legislative recommendations.

First, provisions regarding civil tort liability should be established to address algorithmic discrimination. It is proposed that "liability for damages resulting from algorithmic bias" should be incorporated into the judicial interpretation of the tort liability chapter of the *Civil Code*. This inclusion should explicitly state that if the unequal distribution of health rights and interests arises from data bias or model defects, the affected parties have the right to seek damages. The burden of proof should adhere to the principle of "preliminary evidence transfer", whereby the operator is required to demonstrate the absence of foreseeable bias risks within their system.

Second, a legal framework for the "contextualized consent" system is established to govern data processing. The "contextualized consent" model proposed in this article mandates that data collectors clearly communicate the primary purpose at the initial point of collection, obtain renewed consent when there is a substantial change in the purpose, and afford data subjects the right to withdraw consent at any time[34]. This framework offers a legal foundation for transitioning personal information protection in intelligent healthcare from "static authorization" to "dynamic governance".

Third, a mandatory guarantee of "human intervention rights" in automated decision-making processes is established. It is recommended that specialized legislation explicitly require that significant automated decisions affecting personal health rights and interests must retain a manual review process. Furthermore, individ-

uals impacted by such decisions should have the right to request a review within a specified timeframe. This provision serves as a normative response to uphold the principle of human subjectivity.

The fundamental approach to reconstructing institutional ethics at the legal and regulatory level involves consolidating the ethical principles dispersed across various policy documents into behavioral rules with explicit legal consequences through the legislative process. This ensures that actions violating ethical standards "incur costs, are subject to accountability, and provide avenues for redress". Institutional ethics supported by legal enforcement mechanisms are essential for effectively addressing the challenges associated with intelligent public health governance.

6 Conclusions: advancing intelligent public health governance centered on a foundation of institutional ethics

The analysis presented in this article uncovers a counterintuitive conclusion: the fundamental causes underlying the challenges encountered by intelligent public health governance, such as algorithmic discrimination, privacy crises, and ambiguous responsibility, are not technical flaws but rather the systematic lack of institutional ethics. Intelligent technologies, through the "implicit substitution" of the four principles of transparency, accountability, fairness, and autonomy, have contributed to the phenomenon of "institutional hollowness". The approach of technical ethics—whether exemplified by VSD at the design stage[24] or ethical review at the application stage—cannot supplant the ethical reconstruction required at the institutional level. Rather, there exists a risk of descending into the "trap of ethical technologization".

The theoretical contributions of this article can be summarized at three levels. First, it introduces a diagnostic framework addressing the absence of institutional ethics, thereby reframing the ethical dilemma from a "technical" to an "institutional" perspective. Second, by integrating VSD and institutional ethics theories, it proposes the "dual embedding" of values and institutions. Third, it advocates for the development of a three-tiered institutional reconstruction plan centered on the core concepts of "precaution, human subjectivity, and justice". This study remains an exploration at the level of theoretical frameworks. The practical reconstruction of institutional ethics will inevitably encounter dual resistance arising from institutional inertia and vested interests. Ultimately, the legitimacy of intelligent public health governance derives not from the precision of algorithms but from the humanity of the system; it hinges on the capacity to preserve an inviolable space for human dignity, rights, and justice within the system.

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application-oriented talents in private universities, and the adaptability to grassroots medical positions, the pharmacist examination, and professional construction significantly increases.

This research still has certain limitations. For instance, the interactivity and immersion of the virtual simulation system need to be further enhanced, and the long-term mechanism for school-enterprise cooperation needs to be further institutionalized. Quantitative comparative data on the reform effects need to be collected and analyzed more systematically. In the future, it is needed to explore AI-assisted personalized learning path recommendations, deepen the application of virtual simulation technology, expand the coverage of school-enterprise cooperation, and conduct more rigorous quasi-experimental studies to verify the reform effects, and continuously improve the construction model of this course.

The construction of the Traditional Chinese Medicine Pharmacology course is centered around the goal of cultivating applied talents, forming a complete teaching system with clear positioning, practical content, solid practice, and scientific evaluation. It has advantages of clear reform concept, feasible implementation path, and obvious educational effect. It provides a reference practical model for the high-quality construction of core courses in the traditional Chinese medicine major in private universities.

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