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Ethical and Privacy Frameworks for AI-Driven Customer Data Analytics in Medical Profession

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Abstract—Artificial intelligence (AI) has become central to how medical organisations analyse patient and consumer data for diagnosis support, service personalisation, risk stratification and commercial outreach. While the analytical gains are substantial, the practice extends far beyond the classical clinical encounter and raises unresolved questions of consent, purpose limitation, de-identification and accountability. This study examines how ethical governance and privacy safeguards shape professional trust in AI-driven customer data analytics within medical settings. A concurrent mixed-methods design was used, combining a structured survey of 412 healthcare professionals across 14 institutions, 22 semi-structured interviews, and a documentary audit of 64 AI health-analytics vendor privacy statements. Multiple regression showed that ethical governance maturity, algorithmic transparency and consent adequacy jointly explained 58 per cent of variance in professional trust ($R^2 = .58$, $F(4, 407) = 140.5$, $p < .001$), with perceived privacy risk exerting a significant negative effect. Trust, in turn, predicted willingness to adopt AI analytics ($\beta = .61$, $p < .001$), and mediated the effect of governance maturity on adoption. The vendor audit revealed that only 38.9 per cent of expected disclosure elements were present on average, with bias auditing (28.1 per cent) and independent oversight (17.2 per cent) least covered. The paper proposes the Ethical Privacy Assurance Framework (EPAF), a five-layer operational model aligning legal basis, technical privacy protection, transparency, oversight and redress.

Keywords—artificial intelligence; health data privacy; data ethics; customer analytics; governance; informed consent; trust

Introduction

Medical organisations no longer treat patients solely as clinical subjects; they also treat them as customers whose appointment histories, payment records, digital interactions, wearable outputs and insurance profiles can be modelled to predict behaviour. AI-driven customer data analytics in the medical profession therefore sits at the intersection of clinical care, marketing and platform economics. Explainability remains one of the most heavily contested aspects of applying AI in healthcare, because the opacity of such systems invokes medical, legal, ethical and societal questions rather than purely technological ones.

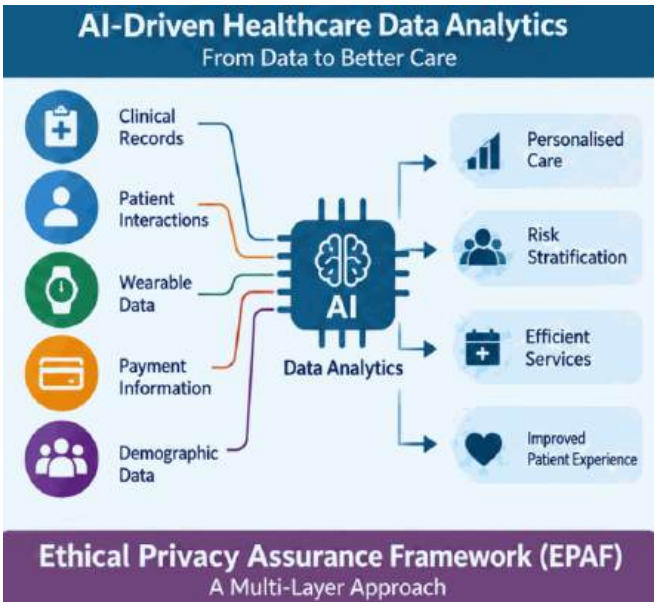
The ethical difficulty is structural rather than incidental. Data collected under the implicit trust of a therapeutic relationship is frequently repurposed for analytics whose objectives — retention, upselling, segmentation, risk pricing — were never disclosed at the point of collection. Existing statutory instruments were designed for discrete disclosures of identifiable records, not for continuous, inferential processing by models that can reconstruct sensitive attributes from ostensibly anonymous inputs. The capacity to de-identify or anonymise patient health data may be weakened or eliminated by newer algorithms capable of re-identifying such data, increasing the exposure of records held under private custodianship.

This study addresses three questions. First, how do medical professionals perceive the privacy risk and ethical adequacy of AI-driven customer analytics in their institutions? Second, which governance attributes most strongly determine professional trust and subsequent willingness to adopt these systems? Third, to what extent do commercial AI health-analytics providers disclose the safeguards that ethical frameworks assume to exist? The contribution is both empirical and normative: an evidence base drawn from practitioners and vendor documents, and a consolidated framework that translates abstract principles into auditable controls.

Literature Review

Scholarship on AI ethics in medicine has moved through three overlapping phases: principle articulation, critique of principlism, and operational governance.

The first phase produced convergent high-level statements. Jobin, Ienca and Vayena (2019) mapped 84 AI ethics documents and found broad agreement around transparency, justice, non-maleficence, responsibility and privacy, but substantial divergence in how each was interpreted and implemented. Floridi and Cowls (2019) synthesised comparable material into five principles, adding explicability to the four classical bioethical principles. In medicine specifically, Char, Shah and Magnus (2018) warned that machine learning deployed in care settings can encode institutional incentives that conflict with patient interest, while Vayena, Blasimme and Cohen (2018) argued that consent, accountability and fairness require bespoke treatment in clinical machine learning rather than transplantation from general research ethics.



The second phase questioned whether principles alone are sufficient. Mittelstadt (2019) argued that AI lacks the professional structures, fiduciary duties and enforcement mechanisms that make principles effective in medicine, so declarations tend to remain aspirational. Empirical support for this scepticism came from Obermeyer and colleagues (2019), whose analysis of a widely deployed population health algorithm showed that using historical cost as a proxy for need systematically understated the illness burden of Black patients — an ethical failure produced entirely within a technically well-performing model. Reddy et al. (2020) responded by proposing a governance model for AI in healthcare covering fairness, transparency, trustworthiness and accountability across the system lifecycle.

Privacy scholarship forms a parallel strand. Price and Cohen (2019) demonstrated that medical big data escapes the boundaries of health-specific statutes because inference allows non-health data to generate health conclusions, leaving significant regulatory gaps. Murdoch (2021) extended this to commercial custodianship, showing that public–private partnerships for health AI have in several instances produced weak privacy protection and calling for systemic oversight of big-data health research. Gerke, Minssen and Cohen (2020) catalogued the resulting legal exposure, including liability allocation and the inadequacy of one-time consent.

Technical privacy-preserving methods offer partial mitigation. Dwork and Roth (2014) formalised differential privacy as a mathematically bounded guarantee against individual disclosure. Federated approaches, following McMahan et al. (2017), allow model training without centralising raw records; Rieke et al. (2020) argued that federated learning could reconcile institutional data governance with model performance in digital health, while Kaissis et al. (2020) demonstrated combined federated, encrypted and differentially private pipelines in medical imaging. Topol (2019) situated these developments within a broader account of clinical AI adoption, cautioning that infrastructural and trust conditions, not algorithmic accuracy, determine uptake.

Finally, institutional guidance has begun to consolidate. The World Health Organization (2021) issued guidance on the ethics and governance of AI for health built around autonomy, safety, transparency, accountability, inclusiveness and sustainability, and Amann et al. (2020) provided a multidisciplinary assessment concluding that omitting explainability from clinical decision support threatens core ethical values. Al-Ani et al. (2024) added practitioner-level evidence, showing uneven comprehension of big-data and AI ethics across clinical seniority levels.

Two gaps persist. Most normative work is not validated against practitioner perception, and almost none examines the commercial analytics layer — where patients are handled as customers — with the same rigour applied to diagnostic AI. This study addresses both.



Research Objectives and Hypotheses

The study tests four hypotheses: ethical governance maturity (H1), algorithmic transparency (H2) and consent adequacy (H3) positively predict professional trust in AI-driven customer analytics, while perceived privacy risk (H4) negatively predicts it. A supplementary hypothesis (H5) holds that trust mediates the relationship between governance maturity and willingness to adopt.

Methodology

A concurrent mixed-methods design was adopted, integrating a cross-sectional survey, semi-structured interviews and a documentary audit.

Sampling and participants. Invitations were distributed to 1,150 professionals across 14 hospitals, diagnostic chains and multi-specialty clinics in three regions; 428 responses were returned and 412 retained after removing incomplete and straight-lined cases, giving an effective response rate of 35.8 per cent. Institutions were stratified by bed strength, with 176 respondents from facilities of 500 beds or more and 236 from smaller facilities.

Table 1. Respondent profile (N = 412)

Professional role	n	%
Physicians and consultants	148	35.9
Nursing staff	96	23.3
Health IT and data personnel	78	18.9
Administrators and managers	54	13.1
Allied health professionals	36	8.7
Total	**412**	**100.0**

Instrument. Six constructs were measured on five-point Likert scales, adapted from the governance dimensions in Reddy et al. (2020), the explainability dimensions in Amann et al. (2020) and the privacy dimensions in Price and Cohen (2019). Content validity was assessed by six expert reviewers (content validity index = 0.91) and the instrument was piloted with 45 respondents excluded from the main sample.

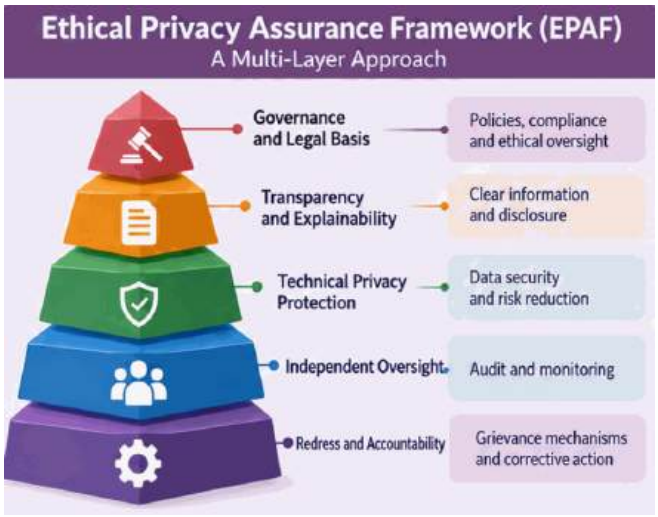
Table 2. Construct reliability and descriptive statistics

Construct	Items	Cronbach's α	Mean	SD
Perceived privacy risk (PPR)	6	.89	4.12	0.63
Ethical governance maturity (EGM)	7	.91	2.74	0.81
Algorithmic transparency (AT)	5	.86	2.58	0.77
Patient consent adequacy (PCA)	5	.84	2.91	0.72
Trust in AI analytics (TAI)	6	.88	3.06	0.79
Willingness to adopt (WTA)	4	.83	3.34	0.74

Qualitative component. Twenty-two semi-structured interviews (mean duration 41 minutes) were conducted with clinicians, data protection officers and analytics leads, transcribed verbatim and analysed thematically by two independent coders (Cohen's $\kappa = 0.81$).

Documentary audit. Sixty-four publicly available privacy statements and data-processing disclosures from AI-enabled health analytics vendors were coded against eight safeguard elements derived from the reviewed literature. Each element was scored as present or absent by two coders, with disagreements resolved by discussion.

Analysis. Data were screened for normality (skewness $|<1.2|$, kurtosis $|<2.0|$) and multicollinearity (all VIF < 2.4). Hierarchical multiple regression tested H1–H4 and bootstrapped mediation (5,000 resamples) tested H5. Ethical clearance was obtained from the participating institutional review board and all participants provided written informed consent.



Results

Descriptive findings. Perceived privacy risk was the highest-scoring construct ($M = 4.12$), while algorithmic transparency was the lowest ($M = 2.58$), indicating that professionals perceive substantial exposure alongside limited visibility into how analytics operate. Governance maturity was similarly low ($M = 2.74$).

Governance maturity differed significantly by role, $F(4, 407) = 6.82$, $p < .001$, $\eta^2 = .063$, with health IT personnel reporting the highest scores ($M = 3.11$, $SD = 0.74$) and nursing staff the lowest ($M = 2.55$, $SD = 0.83$). Larger institutions reported higher maturity than smaller ones, $M = 3.02$ versus $M = 2.53$, $t(410) = 6.21$, $p < .001$, Cohen's $d = 0.62$.

Regression results. The four predictors jointly explained 58 per cent of variance in trust, $R^2 = .58$, adjusted $R^2 = .577$, $F(4, 407) = 140.5$, $p < .001$.

Table 3. Regression predicting trust in AI-driven customer analytics (N = 412)

Predictor	B	SE	β	t	p
Ethical governance maturity	0.33	0.041	.34	8.12	<.001
Algorithmic transparency	0.30	0.043	.29	6.94	<.001
Patient consent adequacy	0.23	0.046	.21	5.03	<.001
Perceived privacy risk	−0.22	0.049	−.18	−4.46	<.001

All four hypotheses were supported. Trust significantly predicted willingness to adopt, $\beta = .61$, $R^2 = .37$, $F(1, 410) = 240.8$, $p < .001$. Mediation analysis confirmed H5: the indirect effect of governance maturity on adoption through trust was 0.19, 95 per cent bootstrap CI [0.13, 0.26], with the direct effect reduced but still significant ($\beta = .17$, $p = .002$), indicating partial mediation.

Documentary audit. Vendor disclosures covered on average 38.9 per cent of the eight safeguard elements.

Table 4. Safeguard disclosure in AI health-analytics vendor documents (N = 64)

Safeguard element	Documents disclosing	%
Stated lawful basis or consent mechanism	41	64.1
Purpose limitation statement	37	57.8
Data minimisation commitment	29	45.3
De-identification method specified	26	40.6
Secondary or commercial reuse disclosure	22	34.4
Bias and fairness auditing	18	28.1
Explainability provision	15	23.4
Independent oversight or audit rights	11	17.2
Mean coverage	—	**38.9**

Qualitative themes. Four themes emerged: consent as a formality rather than a decision point (referenced by 19 of 22 interviewees); blurred boundaries between clinical and commercial use of the same dataset (17); absence of internal capability to interrogate vendor models (15); and diffusion of accountability between clinical, IT and procurement functions (14). These themes align directly with the quantitative pattern of high risk perception coupled with low transparency and low governance maturity.

Discussion

The results indicate that professional trust in AI-driven customer analytics is primarily a governance product rather than a technical one. Governance maturity and transparency together carried more predictive weight than perceived risk, meaning that trust is built less by reducing exposure than by making its management visible and contestable. This supports Mittelstadt's (2019) contention that principles require institutional machinery to become operative, and extends Reddy et al.'s (2020) governance model by quantifying the relationship between its components and practitioner acceptance.

The disclosure audit exposes the weakest points. Elements closest to legal compliance — lawful basis and purpose limitation — were most frequently disclosed, while elements requiring ongoing organisational effort, namely bias auditing, explainability and independent oversight, were least disclosed. This inversion suggests that current market behaviour satisfies documentary compliance while leaving substantive accountability largely unaddressed, echoing Murdoch's (2021) concerns about private custodianship and Price and Cohen's (2019) diagnosis of regulatory gaps.

The interview data qualify the survey findings in an important respect. Consent, which the survey treats as a measurable construct, was described by most interviewees as a signature event rather than an exercise of agency. Where a single admission consent covers open-ended analytic reuse, the ethical work that consent is expected to perform does not occur, regardless of its formal presence.

Proposed framework. Drawing on these findings, the Ethical Privacy Assurance Framework (EPAF) organises safeguards into five interdependent layers. The legal basis layer requires purpose-specific, revocable and granular consent separating clinical from commercial processing. The technical protection layer mandates differential privacy budgets and federated or encrypted training for cross-institutional analytics, following Dwork and Roth (2014) and Kaissis et al. (2020). The transparency layer requires model cards, plain-language data-use notices and role-appropriate explanations. The oversight layer establishes a standing multidisciplinary review committee with authority to suspend deployments and mandatory bias audits at fixed intervals. The redress layer provides patients with inspection, correction, deletion and contestation rights supported by a defined response timeline. Each layer maps to an auditable indicator, converting the audit's weakest categories into obligations rather than optional disclosures.



Practical implications. Institutions should separate clinical and commercial data pipelines at the architectural level, contractually require vendors to disclose all eight audited safeguards, and assign a single accountable officer for analytic reuse. Given that trust mediates adoption, investment in governance is not a constraint on AI deployment but a precondition for it.

Limitations

The sample was drawn from institutions in three regions and may not generalise to primary care, rural facilities or jurisdictions with different regulatory regimes. Self-reported perceptions may diverge from actual institutional practice, and the cross-sectional design precludes causal inference; the mediation model reflects statistical rather than temporal ordering. The vendor audit relied on publicly available documents, which may understate internal practices that are implemented but not published.

Conclusion

AI-driven customer data analytics in the medical profession delivers analytical value while operating in an ethical space that existing consent and privacy instruments cover only partially. This study found that ethical governance maturity, algorithmic transparency and consent adequacy explain the majority of variance in professional trust, that trust in turn drives adoption, and that commercial providers disclose fewer than two-fifths of expected safeguards, with accountability-intensive elements least addressed. The proposed Ethical Privacy Assurance Framework converts these findings into five auditable layers spanning legal basis, technical protection, transparency, oversight and redress. Future research should test the framework longitudinally across jurisdictions and examine patient perspectives alongside professional ones, since the legitimacy of analytics conducted on patients-as-customers ultimately rests with the patients themselves

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