



Assessing Awareness and Perceptions of AI Ethics in Oman's Healthcare System

Sulaiyam Aziz Masoud Al Rumaidhi¹, Intan Sazrina Saimy²

¹Universiti Teknologi Malaysia, ²Faculty of Artificial Intelligence, Universiti Teknologi Malaysia

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Abstract

Background: AI now performs diagnostic, triaging and administrative tasks in hospitals, raising concerns about liability for algorithmic errors, protection of patient information, and explainability. Few studies report actual knowledge of these issues among healthcare providers in Oman. **Objective:** To ask how aware healthcare professionals and stakeholders in Oman's healthcare system are of the ethical considerations attached to AI use. **Methods:** A qualitative interpretive design was used. Twenty semi-structured interviews were undertaken between September 2023 and January 2024 with purposefully selected stakeholders across the Quadruple Helix: government (n = 7), academia (n = 5), industry (n = 5) and non-governmental organisations (n = 3). Records were thematically coded in NVivo 15 following Braun and Clarke, using Rest's Four-Component Model and Scott's Institutional Theory. **Results:** All 20 respondents raised both themes: limited awareness of AI ethics, and AI ethics literacy gaps. Awareness diverged between respondents in the same category and drew little support from formal institutional dialogue. Privacy appeared in every record; bias, transparency and accountability in roughly two thirds; explainability in only four. **Conclusions:** Awareness is conceptual rather than critical, and is contingent upon institutional role rather than personal commitment to ethics. Training, policy and context-specific governance can shape those systems.

Keywords: Artificial Intelligence Ethics, Healthcare Professionals, Moral Sensitivity, Institutional Theory, Oman

Introduction

The Gulf Cooperation Council (GCC), established in 1981, is a regional political and economic union of six Arab states: Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates (Cooperation Council for the Arab States of the Gulf, 2025). Its member states have been embracing artificial intelligence (AI), just like many other healthcare systems around the world. AI has been applied to enhance diagnosis, support clinical decision making, develop more targeted treatments, and expedite clinical activities. There is considerable interest in implementing AI technologies in healthcare services in the GCC countries as part of their broader digital transformation initiatives (Al Zaabi & Padela, 2024). In Oman, these are being implemented in line with national reform objectives for improving government efficiency and

public service delivery through digital transformation (Awashreh, 2025). Interest in using AI applications to promote better patient outcomes and optimise resource usage continues to be most rapidly developing in the healthcare industry.

There have been several recent studies conducted in Oman that have indicated that, while there was some moderate awareness and a largely positive view toward AI by both medical students and medical professionals, there were still gaps in knowledge, acceptance, and preparedness to effectively implement AI applications. For example, Al-Marzouqi et al. (2025) noted moderate levels of knowledge and attitude toward AI applications among healthcare workers at hospitals in the North Al-Batinah governorate area, but also noted potential barriers to effective application. Al Kindi et al. (2025) documented wide variation in physicians' knowledge and views on the role of large language model technology in clinical practice and suggested this could lead to different levels of preparedness across professional disciplines. Pharmacy student surveys indicate an additional trend. There were reports of active engagement with AI tools used by pharmacy students, however, they expressed concern regarding their lack of formal education and training and ethical considerations regarding reliance on those tools (Ba Makhalef et al., 2025; Al-Ghazali, 2025).

These studies offer a useful starting point for understanding levels of knowledge, views and preparedness of all health-care workers. The studies are based on similar methodologies, namely quantitative cross-sectional surveys, which provide a good methodological basis for establishing levels of general awareness and perceptions. However, such studies do not provide insight into how healthcare professionals understand the ethical aspects of the use of artificial intelligence within an institutional setting. Understanding the ethical issues associated with the use of artificial intelligence, including but not limited to, potential algorithmic bias, lack of transparency and resultant legal liabilities; accountability, and the maintenance of patient centred care has been discussed at length by researchers interested in developing responsible strategies for deploying AI (Al Zaabi & Padela, 2024).

Religious beliefs, sociocultural values and family-based decision making processes are common factors across many Gulf States and collectively impact the dynamics between doctors and patients. Awareness of AI, does not equate to being ethically literate. Medical students and physician studies conducted in Gulf States have demonstrated favourable attitudes toward AI while demonstrating continued apprehension regarding who bears legal responsibility and who retains decision-making authority (AlZaabi et al., 2023). Public perception studies in neighbouring states demonstrate varied or negative attitudes toward the use of AI in healthcare, primarily related to privacy and trust (Jarab et al., 2025). Ethical concerns, including but not limited to, objectivity, transparency, and bias, have been identified as primary impediments to the acceptance and adoption of AI in Oman (Mudhsh & Mohammed, 2025; Al Salmi et al., 2024). Collectively, these studies suggest that awareness of ethics is dependent upon context and that qualitative research represents the most effective means to identifying this awareness.

Oman has taken systematic action to improve evidence-based decision making through health technology assessments at a policy level (Al Rashdi et al., 2024). In addition to institutional infrastructure, governance structures are required to address the ethical considerations involved with emerging AI technologies so that healthcare providers can

ethically interact with AI systems within the context of clinical practice. To date research regarding the Omani readiness and perception of AI has failed to assess how healthcare provider stakeholders view the ethical implications of using AI in a healthcare setting. There is very little information available concerning the degree of their awareness as it relates to ethics, what influences their beliefs about ethics related to AI and what barriers they believe exist to successful AI integration into their work practices. This study addresses that gap through the following research question:

RQ: How aware are healthcare professionals and stakeholders in Oman's healthcare system of the ethical considerations associated with the use of AI?

This research expands upon the current body of limited qualitative work examining AI ethics within Omani healthcare by developing new areas of inquiry. In a first way, this study builds beyond mere assessments of the health sector's readiness for AI to focus on awareness of its ethical aspects. In a second manner, the results of this study will be specific to the cultural and socio-economic contexts of Oman; providing evidence-based guidance to develop policies, create regulatory standards, and support professional training programmes focused on sustainable AI governance. In a third manner, this study will identify gaps in both ethical literacy and preparation for AI implementation among various groups of healthcare stakeholders; informing an institutionally-focused capacity building agenda. The findings generated from this research also contribute to a broader regional conversation regarding the development of culturally-sensitive and ethically-sound approaches to implementing AI into Gulf-region healthcare systems.

The remaining sections of the paper are structured to follow a logical sequence. A review of literature on the integration of AI into healthcare, the ethical concerns related to such implementations, and the level of awareness regarding these issues is provided in the subsequent section. Methodology section outlines the design and sampling strategy employed in this study, including data collection methods and the process of thematic analysis used to generate findings. Next, the findings generated from this research are presented in relation to extant literature. Finally, the paper concludes by outlining potential implications for both policy and practice, discussing limitations of this study, and identifying avenues for further research.

Literature Review

Opportunities and Risks in Ethical AI in Healthcare

The literature states that AI in healthcare represents a turning point, associated with increased diagnostic accuracy, individualised care pathways, improved operational efficiency, and greater availability of care. Systematic reviews indicate that AI provides support for clinical decision-making, assists with optimal use of resources, and facilitates the flow of work (Chustecki, 2024; Sunarti et al., 2021). According to Sunarti et al. (2021), AI benefits include enhanced diagnosis capabilities, improved management efficiency, and expanded preventive options. Additionally, Chustecki (2024) indicates AI supports precision health and the optimisation of systems. Alikperova (2023) views AI as an important component of larger digital transformations that provide strategic means to improve the quality and affordability of healthcare. All of these works contain a techno-optimistic view in which AI creates systemic change.

There exists a consistent dilemma in the discussion regarding the role of AI in healthcare; the relationship between technological opportunity and ethical risk. While the positive aspects of AI are emphasised, the negative consequences are treated as secondary implementation issues rather than as foundational concerns of both AI's design and governance. Chustecki (2024) found that among the 44 reviewed studies there were four major areas of concern related to the ethics of using AI in healthcare; algorithmic bias, transparency of decision making processes, threats to patient confidentiality/privacy, and patient safety. Each of these areas present direct challenges to clinical judgement, patient autonomy and fairness in delivering medical services. Furthermore, algorithms used in healthcare can perpetuate health inequities where the training dataset is not representative. Thus, any claims made about AI increasing equality of access to healthcare would be undermined (Corfmat et al., 2025; Elendu et al., 2023).

Transparency and explainability also arise as ethics issues. As clinicians have difficulty interpreting and justifying the decisions made by the AI-based decision-support system, they may view these systems as black boxes. According to Mennella et al. (2024), lack of transparency under weak governance structures reduces both clinician's sense of professional responsibility and their confidence in an AI system. Explainability is important in situations involving high levels of clinical decision making, particularly in cases requiring informed consent and collaborative decision-making. In addition to concerns for safety and risk management related to the increasing use of AI to analyse large volumes of healthcare data using little or no human oversight (Samokisheva et al., 2024), privacy and governance raise additional ethical challenges. Healthcare data must be aggregated on a large scale to operate most effectively as an AI system. This raises concerns about confidentiality, ownership and secondary uses of highly confidential information (Corfmat et al., 2025; Elendu et al., 2023). These privacy and governance challenges may be mitigated through technical means including encryption, de-identification, and decentralised data storage and sharing. However, technology cannot resolve normative questions regarding patient consent and control over individual patient health information. When AI produces an adverse outcome in a situation in which there is a lack of regulation and therefore a lack of accountability/ethics professionalism becomes uncertain (Mennella et al., 2024).

An additional aspect of this debate focuses on the sociotechnical impact that AI has had upon the healthcare professionals who are using it. The sociotechnical impacts include changing the roles of the profession; changing the education and training for those professions; and altering the workforce dynamics. These impacts create new ethical challenges which are separate from protecting the patient. For example, AI impacts the clinical authority of a provider, the relationship between a provider and a patient; and creates new dependencies on technology systems. Therefore, the ethical risks of implementing an AI system into a healthcare organisation extend beyond just the safety/privacy of a patient's information to also include the professional identity and the responsibility/accountability of the institution. AI in healthcare is, on this account, high-reward and high-risk at once. Most research in this area has focused on either the capabilities of the technology or the responses of governments and other organisations to these technologies. However, there has been little effort by researchers to determine how healthcare professionals perceive or understand the risks associated with them. This omission matters most in non-Western contexts, where cultural, regulatory, and institutional conditions may shape ethical awareness differently.

Ethical Dimensions of AI in Healthcare Practice

Ethical questions surrounding the use of artificial intelligence (AI) in healthcare have drawn increasing scholarly attention. The primary focus of this interest has been ensuring justice and fairness in how AI systems provide their recommendations for treatment based upon clinical data. AI systems develop and validate models from data sets which may include some degree of bias due to past discrimination and inequality within the healthcare system. This type of bias can result in unfair treatment or discrimination against marginalised populations. Weiner et al. (2025), assert that non-representative data sets along with biased algorithms in developing AI systems may exacerbate disparities in healthcare while undermining the principles of justice in clinical practice. On the other hand, Jha et al. (2025), contend that if the race-based bias is removed from the training data set and the algorithms are made fairer then AI may potentially be able to democratise healthcare through providing more equitable access to quality diagnostic assistance. However, there is a contradiction here; AI is being marketed as an equaliser in terms of equity in delivering healthcare services, however, it will continue to perpetuate structural inequities if ethical considerations are not incorporated during both design and implementation.

The second major aspect of ethics regarding the use of AI in clinical decision making is transparency and explainability. Most contemporary AI systems used for assisting clinician's decision-making processes are complex and therefore difficult to interpret accurately. As such, the lack of transparency in AI systems creates problems related to professional accountability. Weiner et al. (2025), suggest that the reason many patients lose trust in healthcare providers when they rely on automated systems for supporting clinical justifications is because the lack of clarity in the algorithms used to support those systems.

Badawy et al. (2025), describe transparency and accountability as two central areas of concern in relation to nursing practice, and emphasise that healthcare professionals need to maintain the ability to articulate why they took certain actions or decided on specific care decisions regardless of whether the clinician was using technology like AI to assist them. If the AI system does not allow for sufficient explanation of its recommendations, clinicians may find themselves unable to reconcile what the AI suggested with their own professional judgement and ethical practices.

Privacy and the rights of patients also create an additional challenge for the use of AI. Most AI technologies collect and process large amounts of confidential health data to function effectively; therefore they raise several questions regarding consent, confidentiality and how this data will be managed. Ibrahim et al. (2025) have stated that there are ethical considerations with regards to patient privacy, information protection and liability/accountability with AI in nursing practice across Arab nations. Lin et al. (2024), noted that informed consent and protecting client's personal information is an important consideration when AI is used in healthcare and medical education. Both authors indicated the importance of establishing ethical and regulatory structures to provide patient autonomy while at the same time providing a means to innovate.

There are additional social and professional implications to the introduction of AI into clinical practice beyond the realm of individual ethics. Rosemann and Zhang (2022) emphasised that the implementation of AI creates cross-disciplinary ethical, legal and social challenges with

respect to trustworthiness, regulation, changes to the healthcare workforce, and access to healthcare. The role of professionals, methods by which clinicians work, and employment trends in healthcare are all affected by AI technology. There are also humanistic care aspects of the ethical considerations related to AI as well, specifically in the areas of nursing and palliative care, as both involve human relationships and compassion. Oh et al. (2025), emphasise that ethical principles should be established to assess the application of AI in sensitive care environments such as end-of-life care, as well as those involving beneficence, non-maleficence, autonomy, justice, and explication.

Recent empirical studies point in a consistent direction. In a study by Zavaleta-Monestel et al. (2025), which included surveying eighty healthcare professionals at one hospital in Costa Rica, the researchers concluded that respondents indicated a generally moderate level of familiarity with AI; however, they also expressed a need for governance frameworks to address the complex ethical and regulatory issues surrounding AI implementation. As reported by Weidener and Fischer (2024), there was overwhelming support among medical students for the importance of educating them about ethics of AI, although, formal instruction regarding this topic is virtually non-existent within the majority of medical educational programmes. A marked divide therefore separates the increasing use of AI technologies in healthcare from the ability of healthcare practitioners to understand and respond to its ethical implications. The divide is particularly relevant in countries like Oman where rapid growth in digital health technologies is occurring. Understanding awareness and perceptions of AI ethics is the starting point for developing contextually appropriate governance frameworks.

Awareness and Ethical Literacy Among Healthcare Professionals

Ethical literacy is the ability to understand, analyse, and address the ethical issues associated with technology-based systems. The increasing presence of artificial intelligence (AI) systems in clinical decision making has increased the need for this type of literacy. There appears to be some evidence that there still exists a lack of awareness regarding ethical issues by healthcare providers. Weiner et al. (2025), describe four main types of ethical concerns that arise from the use of AI in clinical settings including; justice and fairness, transparency and how decisions are made, informed consent and confidentiality, and finally accountability. They also point out that if the training data used to create AI systems does not represent all groups appropriately, then these systems could either continue or exacerbate discrimination. Jha et al. (2025) further state that both the existence of bias in training data and fairness of algorithms will determine whether the potential benefits of using AI exist. Therefore, healthcare professionals must be aware of these issues so they can assess the potential outcomes of AI system output. If healthcare professionals do not have the knowledge necessary to recognise and evaluate the outcomes of AI system output, it is likely that they will rely on those outputs without evaluating them, thus potentially continuing systemic inequities in healthcare. Finally, Archibong et al. (2025) noted that while AI systems provide many new capabilities for assisting in medical diagnosis, they also present new legal and ethical issues including liability, accountability and what happens when the recommendations provided by the AI system result in an inaccurate diagnosis.

Research studies have shown a slow development of ethical awareness compared with the enthusiasm for using AI in healthcare. While Alsaedi et al. (2025), reported that there was a

general willingness by most physicians and nurses to utilise AI in their clinical work; they also stated that there were an insufficient number of skills and knowledge to be able to do so. The major concerns for the respondents were about data privacy and who would take responsibility when AI made mistakes. A difference thus emerges between the perceived benefits of AI and what is required for its ethically responsible application. Bhaumik (2025) argued that discourse on AI in healthcare has been concerned with efficiency and innovation but has failed to examine the deeper ethical and epistemological questions including uncertainty regarding knowledge produced through algorithms and lack of moral agency in AI systems. Therefore, stronger institutional regulation, ethical governance instruments and ongoing education are needed to create greater awareness of ethical considerations for all healthcare stakeholders. Two limitations of this body of work define the gap addressed here.

Empirically, the available Omani evidence consists of quantitative cross-sectional surveys that measure self-rated knowledge of, attitudes towards, and readiness for AI among individual practitioners and students (Al-Marzouqi et al., 2025; Al Kindi et al., 2025; Ba Makhalef et al., 2025; Al-Ghazali, 2025). These designs establish how widely AI is accepted, but they do not examine which ethical concepts professionals are able to name and reason about, and they sample individual clinicians and students rather than the policy, industry and civil-society actors who set the conditions within which clinicians act. Theoretically, the studies that do report ethical concern treat it as an individual attribute to be raised through training, and therefore cannot explain why awareness varies between professionals working under the same national policy, or why some categories of AI risk are recognised while others are never mentioned. What is missing is an account that specifies ethical awareness precisely enough to be observed and locates its variation in the institutional conditions that make particular risks nameable.

Theoretical Framework

This study draws on two frameworks, each with a distinct analytical function. Rest's Four-Component Model of Moral Behaviour specifies the phenomenon under investigation. Scott's Institutional Theory supplies the account of why that phenomenon varies across professionals working within one health system. Combining them is the study's theoretical contribution. Rest's model has been applied to the ethical competence of individual practitioners (Chambers, 2011; Ha & Oh, 2025; Zhang et al., 2025), where uneven moral sensitivity is attributed to individual development, while Scott's (2014) pillars characterise the institutional environment without specifying what, at the level of the individual professional, that environment produces. Linking the two treats moral sensitivity as a capacity that institutions distribute rather than a personal trait, which yields a proposition that can be examined against data: the categories of AI risk that professionals recognise should follow the categories their institutional environment names. This is analytically useful in Oman, where AI is being introduced under a general data-protection law (Sultanate of Oman, 2022) in the absence of AI-specific rules, so that professional norms and shared understandings are forming without regulative anchoring for risks such as bias, explainability and algorithmic accountability.

Moral sensitivity as the object of study

Moral sensitivity as the object of study. Rest (1986) treats ethical decision-making as a process of four interrelated components: (1) moral sensitivity, (2) moral judgement, (3) moral

motivation, and (4) moral character. Ethical behaviour starts with moral sensitivity, the ability to recognise that a situation carries ethical implications and to see how actions may affect others. Without that first recognition, individuals rarely reach the later stages of ethical reasoning and action. AI raises the stakes on this component, because healthcare professionals must first recognise concerns such as algorithmic bias, data privacy, and accountability before anyone can evaluate or address them. The model has been applied widely in healthcare. Chambers (2011) used it to assess ethical skills among healthcare professionals and treated moral sensitivity as foundational to professional ethical behaviour. Ha and Oh (2025) link ethical competence among nurses to the ability to identify ethical dilemmas in clinical environments. Zhang et al. (2025) report that higher moral sensitivity accompanies more responsible professional conduct and better patient care. Because the research question concerns awareness of the ethical issues AI raises, this study focuses on the moral sensitivity component.

Institutional conditions as the explanatory frame

Scott (2014), states that it is the institutional environment and not just technological aspects that influence an organisation's approach to a technology. He also outlines the three ways in which this institutional environment impacts on organisational behaviour. The institutional environment operates through three pillars. The first is the regulative pillar, which includes law, formally prescribed rules, and policy mechanisms, among them data protection standards, accountability requirements, and safety rules governing the use of AI. The second pillar is the normative pillar. This includes, amongst other things, professional norms, ethical codes of practice, training practices and what practitioners perceive their role to be. The third pillar is the cultural cognitive pillar. This encompasses the collective belief system and assumptions about a technology and its legitimacy. Together these three pillars will ultimately define which factors are deemed acceptable, expected or even capable of being thought about in relation to a particular profession.

Integrating the two frameworks

Integrating the two frameworks. Rest's view of ethics views moral sensitivities in most cases as an individualised attribute which is developed by formal moral training or informal experience. Rest's model does not, however, indicate where the concepts required for recognition come from. However, Scott provides answers to those questions. His pillars provide the context in which the ethical aspects of new technologies can be named, or recognised, within a specific professional community. The two frameworks are complementary to each other. Rest identifies what is being observed; Scott explains its distribution. Together they yield a proposition that can be examined against the present data.

Where the regulative pillar supplies no rules for a category of AI risk, then the normative pillar will have no common professional expectations regarding this type of AI risk, and the cultural-cognitive pillar will not provide a framework that allows practitioners to recognise it. Therefore, regardless of individual commitment to ethics, there will be little moral sensitivity toward that type of AI risk. This was used as a guide to interpret the results found in the research discussed below.

Methodology

Research Design

Evidence on how healthcare professionals and stakeholders in Oman's healthcare system understand the ethical considerations of AI use is limited, so this study took a qualitative approach. It followed an interpretivist (constructivist) paradigm and an inductive, exploratory design. That design suits the aim: an in-depth reading of ethical awareness in relation to AI, drawn from the accounts of key stakeholders.

Sampling and Respondents

To reach a multi-perspective account of how AI is implemented and integrated within the healthcare system in Oman, the study adopted the quadruple-helix approach as a network model for selecting data sources, covering four category groups: government, industry, academia, and non-governmental organisations (Höglund & Linton, 2018; Miller et al., 2018). Candidate respondents were identified through an initial analysis of Oman's Vision 2040 and Oman's Health Vision 2050, together with the researcher's professional knowledge and experience in the Sultanate of Oman's health sector. Purposive sampling secured respondents with relevant expertise, and snowball sampling identified further respondents within each category group.

Twenty respondents took part: seven government officials (35%), five academic scholars (25%), five industry experts (25%), and three representatives of non-governmental organisations (15%). Each respondent carries a code combining the category abbreviation and a sequential number, and no other identifying detail is reported. Table 1 summarises the composition of the sample.

The large majority of respondents within all four quadruple-helix categories were institutional representatives, policy makers, and senior clinical leaders or administrators. This approach was positioned as an organisation-based assessment, within the policy cycle framework, to assess institutional readiness, identify needs, and anticipate the establishment of AI ethics governance. In this context, "stakeholders" refers to those decision makers and authority figures that are responsible for developing governance and establishing institutions' readiness for AI. They differ from frontline healthcare workers, such as nurses and allied health professionals, who use AI-based tools on a regular basis. The scope is suitable to an organisation-wide interpretation of AI ethics readiness. Capturing the lived experience of those frontline users would require a separate, complementary sample, which is identified in the Study Scope and Limitations section as an area for future research.

Table 1

Respondent characteristics (N = 20)

Category	Respondent codes	n	%
Government officials	GO-1 to GO-7	7	35
Academic scholars	AC-1 to AC-5	5	25
Industry experts	IN-1 to IN-5	5	25
Non-governmental organisations	NGO-1 to NGO-3	3	15
Total		20	100

Note. Respondents are identified by category code only: GO = government official; AC = academic scholar; IN = industry expert; NGO = non-governmental organisation. Institutional affiliations are withheld to protect respondent confidentiality.

Data Collection

Data collection for this research was carried out using semi-structured interviews that utilised an open-ended question format from September 2023 to January 2024. Prior to conducting the primary data collection interviews, a pilot study was conducted. In the pilot study, three senior respondents were interviewed at their workplace. The interviews in the pilot study were audio-recorded and used to refine questioning style and interview conduct. Each interview followed a standard protocol: selection of a location where distractions could be minimised; explanation of the intent behind the interview; discussion of confidentiality terms; description of the type of interview being conducted; estimated length of the interview; provision of contact information to the interviewer; opportunity for respondents to express concerns about the interview; preparation for recording.

Data collection ran alongside preliminary analysis and continued until saturation, the point at which no new significant insights emerged. Saturation was reached after 20 interviews: seven government officials, five academic scholars, five industry experts, and three representatives of non-governmental organisations. Two respondents classified as government officials (GO-6 and GO-7) were interviewed with the non-governmental schedule; this allocation is taken into account in the Fragmented and Inconsistent AI Ethical Awareness section, where the wording of the guides bears on interpretation.

Data Analysis

The thematic content of interviews was analysed through the use of NVivo 15. As outlined by Braun and Clarke (2006), this involved six stages of thematic analysis: familiarity with the data; generation of preliminary coding; exploration for themes; evaluation of themes; development of a definition and name for the theme; and preparation of the final document. Coding used an inductive approach to allow themes to emerge from the data as opposed to being pre-defined. The process had three distinct steps: developing initial open codes based on the data collected; evaluating these initial codes; and eliminating redundant or insubstantial codes. Following this step, all remaining codes were grouped by commonality within categories to develop sub-themes. The sub-themes were then grouped again into main themes. Data collection and analysis occurred simultaneously, providing an opportunity to continually refine identified themes throughout the study.

For the research question addressed in this paper, coding produced two main themes and four sub-themes. Table 2 reports, for each theme and sub-theme, the number of respondents whose interviews contained coded material (files) and the total number of coded segments (references), as generated by NVivo. Appendix A provides the full thematic structure, including the working definition applied to each node.

A simple lexical count supplemented the thematic coding to establish how widely each named ethical concept was distributed across the sample. For each concept, the count records the number of interview records in which the term or a morphological variant appeared, rather than the frequency of occurrence within a record. Those ethical concepts

included: privacy, bias, transparency, accountability, explainability, interpretability and auditability. Each interview guide was also checked to establish whether a question had prompted the concept.

Each quotation referenced in the Results was reviewed for accuracy. Each quotation comes directly from one interview record and is attributed by respondent code. Only one alteration was made to the original record. When respondents' answers extended over two lines in the interview record, those lines were combined into one. Respondents' answers using numbers in lists were maintained as they responded. No other changes were made to what the respondents said. Non-standard English used during interviews was not corrected. Coding of interview data was done inductively. Both Rest's Model and Scott's Pillars did not provide coding categories based on prior assumptions; instead, Rest's Model and Scott's Pillars provided explanations for the patterns found in the data after themes were derived from the data.

Table 2

Coding coverage by theme and sub-theme

Theme / sub-theme	Respondents (files)	Coded references
AI ethical awareness among professionals and stakeholders (overall)	20	984
Limited awareness of AI ethics among professionals	20	379
Fragmented and inconsistent AI ethical awareness	19	274
Lack of formal institutional dialogue on the ethics of AI	19	105
AI ethics literacy gaps	20	605
Absence of standard training in AI ethics	19	137
AI ethical gaps in curriculum and educational integration	20	468

Note. Files denotes the number of respondents whose interviews contained material coded to the node; references denotes the total number of coded segments.

Ethical Considerations

The study was conducted in accordance with the Ministry of Health data-sharing policies and with the Personal Data Protection Law, Royal Decree No. 6/2022 (Sultanate of Oman, 2022). Written informed consent was obtained from every respondent, using a standard consent statement issued with the interview schedule. A confirmation of voluntary participation as well as the right to discontinue at any point without explanation or consequence was provided. Respondents were advised that answers could be declined. Respondents were assured that their anonymity would be preserved and that they would not be identified in any report based on this study. Audio recordings were permitted after confirming that recordings would only be used for purposes of analysis. Furthermore, it was agreed upon that excerpts taken from the recordings would be presented in anonymous form. Finally, it was confirmed that no person outside the research team would have access to the original recordings. Respondents also gave permission for their anonymised data to be retained and

used in publications arising from this study. All identifiers have been removed from this reporting: respondents are referred to only by category code, and institutional identification is omitted.

Results

This study examined how aware healthcare professionals and stakeholders in the Sultanate of Oman are of the ethical considerations attached to AI use. The analysis identified two main themes: limited awareness of AI ethics among professionals, and AI ethics literacy gaps. Both appeared across all 20 interviews, carrying 379 and 605 coded references respectively, that is, individual interview text segments assigned to the node during coding (Table 2). Fig. 1 presents the themes and sub-themes.

Quotations are reported verbatim, each attributed to a single respondent by category code. Where a respondent's phrasing departs from standard English, the wording stands as given rather than corrected, so that the original account is preserved.

Awareness among professionals of the ethical implications arising from the introduction of AI in Oman's healthcare systems is still relatively low. While there are variations in this awareness across professional categories, it has generally been limited to a few key areas. There is also very limited evidence of formal institutional mechanisms to address these concerns, nor have 504tandardized training programmes or curriculum materials to provide such education been developed. As a result, most of the time professionals lack the ability to predict potential ethical risks associated with their use of AI; they lack the knowledge of how to develop safeguards to mitigate those risks; and therefore are hesitant to embrace the use of AI supported clinical decision making. Ethical awareness development becomes necessary to ensure the successful and responsible deployment of AI in the healthcare sector.



Fig. 1. Themes and sub-themes of AI ethical awareness among healthcare professionals and stakeholders in Oman's healthcare system

Limited Awareness of AI Ethics among Professionals

Limited awareness of AI ethics among professionals is the first of the two conditions describing the status of ethical awareness in Oman's healthcare system, and it appeared across all 20 interviews (379 coded references). It refers to insufficient understanding, recognition, or consideration of the moral, security, and societal risks that attach to the development, deployment, and integration of AI technologies. Two sub-themes characterise it: fragmented and inconsistent AI ethical awareness; and a lack of formal institutional dialogue on the ethics of AI.

Fragmented and Inconsistent AI Ethical Awareness

Fragmented and inconsistent ethical awareness refers to a situation in which institutions hold disjointed, incomplete, or divergent levels of understanding of ethical issues. This sub-theme was coded in the interviews of 19 respondents (274 references). The interview guides differed by category. Ten respondents, the five academic scholars and the five interviewed with the non-governmental schedule (GO-6, GO-7, NGO-1, NGO-2, NGO-3), were asked in identical wording how they perceived the current state of ethical awareness regarding AI. Their answers ranged from the categorical to the reassuring:

"Ethical awareness is still in its infancy, with limited discussions and guidelines available on the ethical implications of AI in healthcare."

(AC-1)

"Ethical awareness of AI is growing but remains inconsistent. Unfortunately, many users lacking to recognize issues like bias, privacy, and accountability. More awareness needed to address ethical challenges and deficiency effectively."

(AC-3)

"It is unclear and includes many questions."

"Very low."

(AC2)

(GO6)

"In my opinion, it requires more awareness development."

(AC-5)

"Ethical awareness: The medical staff's awareness is good, but the issue with AI is that if non-medical personnel intervene, it increases the risk of breaching privacy."

(NGO-2)

"The current state of ethical awareness regarding Ethical concerns about AI, such as privacy, misinformation, and accountability, are now widely discussed in media and academic institutions but still requires more awareness in health sector and guidance techniques."

(NGO-3)

"I think that ethical awareness is still in its infancy. With the development of artificial intelligence, new ethical issues related to patients, their data, and medical errors must be considered, as well as cultural differences regarding artificial intelligence that may affect ethical awareness. Institutional responsibility can be added because the regulatory and governance frameworks are not defined."

(NGO-1)

Respondents in the government and industry categories received a differently worded question, asking how aware they were of the ethical challenges associated with the use of AI,

and their answers followed that framing. They located awareness in particular groups rather than assessing it system-wide: clinicians as better informed than other staff (GO-1), the ethical issues themselves as already recognised and monitored (GO-4), and awareness as concentrated in organisations whose work is AI-specific (IN-4):

“High awareness among medical and helpful categories, but needs to raise the level of awareness of the rest of the categories.”

(GO-1)

“Ethical issues such as bias in AI models, transparency, and accountability are well-recognized and monitored.”

(GO-4)

“Awareness is limited to two groups: AI-focused companies that fully understand AI applications in healthcare services and research institutions. However, measuring this awareness accurately is challenging due to the lack of relevant publications and targeted initiatives. In Oman, for example, we only have one leading project: the breast cancer prediction project.”

(IN-4)

Industry respondents did not converge on a single reading of their own sector. One described awareness as increasing but incomplete; two described it as insufficient outright:

“Industries in Oman are becoming increasingly aware of the ethical challenges in adopting AI in healthcare, particularly regarding data privacy, security, and transparency. However, there is still a gap in fully understanding and addressing these issues, especially in terms of developing comprehensive regulatory frameworks and ensuring ethical AI usage throughout the healthcare system.”

(IN-1)

“Awareness of the ethical challenges of artificial intelligence in health services in general is low, but it varies between sectors and may gradually increase in the presence of policies and strategies for this technology.”

(IN-2)

“The awareness of the is not enough for deal with the AI in the healthcare system. Many employees do not cover all ethical points for deploying AI in the healthcare system. Polices of social ethics and AI still in the creation to match them especially in the healthcare sys.”

(IN-3)

Academic respondents traced the inconsistency to two distinct sources: a gap between familiarity with AI as a technology and recognition of its ethical dimensions, and the absence of any legal reference point governing use:

“AI is a revolutionary field, and discussions about its ethical implications are not yet common practice. Many colleagues are aware of the potential of AI but are yet to realize the importance of ethical implications, such as bias and privacy.”

(AC-2)

“The understanding varies widely, with many colleagues lacking a comprehensive grasp of the ethical concerns surrounding AI.”

(AC-1)

“In fact, there are no legislations available to guide end users on AI, and many users, I believe, use AI disregarding the ethics of using, adopting, or implementing AI. For instance, students may use AI without citing the source.”

(AC-4)

A further pattern emerges when respondents' assessments of the system are set beside their assessments of themselves. Two of those who judged system-level awareness most severely described their own understanding in the opposite terms. Asked separately how aware they were of the ethical challenges, GO-6, who had rated the current state as "very low", replied that they were "well informed about the ethical challenges as I have been reading and presenting about this topic in national conferences/workshops". NGO-2, who described medical staff awareness as "good", assessed their own as "weak, because AI in healthcare is vast and complex, with many benefits and drawbacks that are realized after implementation".

The same respondents placed themselves and their environment at different points on one scale, which suggests that these judgements do not reduce to a single underlying estimate.

Two features of these accounts stand out. First, the range of assessments given by the ten respondents who received the question in identical wording is itself evidence of inconsistency. Those assessments ran from "very low" (GO-6), through "still in its infancy" (AC-1, NGO-1) and "unclear" (AC-2), to accounts describing medical staff awareness as "good" (NGO-2) and ethical concerns as "widely discussed in media and academic institutions" (NGO-3). Respondents answering the same question about the same health system did not share a common view of how much ethical awareness exists. Second, where respondents specified the content of that awareness, it spread unevenly across the ethical concepts available to them. Counting the interview records in which each concept was raised, privacy appeared in all 20, bias in 14, transparency in 13, and accountability in 12. Explainability appeared in only four records, interpretability in one, and auditability in none.

One qualification applies to that count. The interview guides for the government-official and industry categories each contained a question referring explicitly to data privacy and security, whereas the academic and non-governmental guides did not, and no guide referred to bias, transparency, accountability, explainability, or auditability. Because GO-6 and GO-7 were interviewed with the non-governmental schedule, privacy was prompted for ten of the twenty respondents and unprompted for the other ten. Restricting the count to the ten respondents who received no such prompt, the five academic scholars, the three representatives of non-governmental organisations, GO-6 and GO-7, privacy was still raised by all ten, bias by seven, transparency and accountability by six each, and explainability by two, while auditability was raised by none. The gradient holds independently of the instrument, and is not an artefact of the questions asked.

The distribution of the thinnest concept is itself informative. Explainability was raised by two of the five industry respondents but by only two of the remaining fifteen. The concept that presupposes proximity to how a system is built was recognised chiefly by those whose institutional position brings them into contact with system design, and was largely absent among those it does not.

Awareness was anchored most firmly in the concept with the longest-established professional and legal vocabulary, and thinned across the concepts specific to algorithmic systems. Its distribution was uneven and its scope narrow. Two respondents tied this directly

to the regulatory position, NGO-1 observing that “the regulatory and governance frameworks are not defined” and AC-4 that “there are no legislations available to guide end users on AI”.

Lack of Formal Institutional Dialogue on the Ethics of AI

Lack of formal institutional dialogue on the ethics of AI refers to the absence of organised, standardised, and binding mechanisms within institutions for discussing, evaluating, and acting on the ethical risks AI poses. This sub-theme was coded in the interviews of 19 respondents (105 references). Academic respondents were asked how often they brought discussions of AI ethics into their teaching or research. They reported such discussion as occasional, informal, or absent:

“Discussions of ethics in AI are not yet a regular part of my research or teaching, largely because AI in healthcare is still a relatively new field with much left to explore. While I occasionally touch on the ethical implications of technology in healthcare, we are limited in discussing AI-specific challenges, like bias in algorithms, patient data security, and slight deviation from human thinking.”

(AC-4)

“Very little.”

(AC-2)

“I have not made any contributions in this field so far.”

(AC-5)

Where dialogue did occur, respondents described it as unstructured rather than institutionally organised, and identified the absence of structured provision as the reason:

“Assessing the understanding of ethical issues in AI among my colleagues is not something I do often, mainly because AI is still a revolutionary and emerging field in healthcare, and discussions about its ethical implications aren’t yet a common practice. When the topic does come up, it’s usually in informal conversations or collaborative projects, where I notice a mix of curiosity and uncertainty. Many colleagues are aware of the potential of AI but are still exploring its ethical dimensions, like bias, transparency, and accountability. It’s clear that more structured opportunities for learning and dialogue are needed to build a deeper collective understanding of these critical issues.”

(AC-4)

“There is an awareness that exists, there are things in ethics, there are relative things, and there are definitive things, but in artificial intelligence, there may be no sessions discussing the subject of ethics of the use of artificial intelligence in the medical field... But I did not see much of the simple workshop that most of the workshop, which talks about the use of artificial intelligence in the health care field, but she did not talk about the ethics of artificial intelligence in the medical field... so this topic may need to be researched and presented to the medical staff.”

(GO-7)

Two industry respondents reported the opposite of this pattern for their own sector, and their accounts are set out here rather than omitted. Asked what industry programmes were in place to raise ethical awareness, IN-1 answered that “industries raise ethical awareness in AI healthcare through training programs, ethical review committees, and collaborations with regulatory bodies”, adding that they “also organize workshops and continuous audits to ensure ethical compliance in AI development”. IN-5 reported that “various institutions and organizations are forming dedicated AI ethics committees to monitor and guide the development of AI technologies”, focused on transparency, fairness, and accountability.

These two accounts are the only reports of standing ethical machinery anywhere in the dataset, and both are located in the technology sector rather than in healthcare delivery or education. Neither respondent named a specific committee, and IN-5's phrasing ("are forming") describes an emerging rather than an established arrangement. The finding reported here is that no respondent described such machinery operating within a healthcare institution; the claim is not that none exists anywhere in Oman. Within healthcare and academic settings, where engagement occurred it was individual and informal, described by AC-4 as arising in "informal conversations or collaborative projects", rather than organised, minuted, or binding. One consequence, noted by IN-4 in the Fragmented and Inconsistent AI Ethical Awareness section, is that the extent of awareness cannot readily be assessed, since there are no publications or targeted initiatives against which to measure it. A second is that the discussion which does take place does not reach the clinical workforce: GO-7 concluded that the topic "may need to be researched and presented to the medical staff", and AC-4 that "more structured opportunities for learning and dialogue are needed". Ethical consideration is reactive, arising in response to particular situations rather than through sustained institutional deliberation.

AI Ethics Literacy Gaps

AI ethics literacy gaps form the second condition describing the status of awareness among healthcare professionals and stakeholders in Oman, and appeared across all 20 interviews (605 coded references). Literacy gaps refer to the distance between the ethical understanding responsible AI use requires and the knowledge and skill currently available to apply it. The condition took two forms: an absence of standard training in AI ethics; and AI ethical gaps in curriculum and educational integration.

Absence of Standard Training in AI Ethics

Absence of standard training in AI ethics refers to the lack of consistent, formal, and widely adopted provision addressing the ethical implications, risks, and responsible use of AI systems. This sub-theme was coded in the interviews of 19 respondents (137 references). Government respondents addressed training provision directly. They identified an absence of specialised provision and specified the form it should take:

"While AI is already being used for data analysis, there is a lack of specialized training. Comprehensive training programs are essential to ensure professionals can effectively integrate AI while adhering to ethical standards."

(GO-3)

"The Oman Medical Specialty Board has begun integrating AI in exams and digital transformation projects. However, there is a need for greater emphasis on AI training, workshops, and awareness programs."

(GO-3)

"Training and qualification of staff is important and necessary in the use of AI technology, but within a specific framework. We believe that the focus should be on training staff on the ethics of AI and dealing with the technology and understanding its functioning."

(GO-5)

Where respondents described existing provision, it consisted of conferences, seminars, and workshops rather than structured or mandatory curricula:

"Holding conferences, seminars, workshops and media."

(GO-1)

“Participation in global initiatives for Ethics in artificial intelligence and participation in conferences and workshops enhances the process of using artificial intelligence. The World Health Organization also issues guidelines on the ethics and governance of artificial intelligence in large-scale and Multimedia models.”

(IN-2)

Respondents were consistent about what such training should contain, and their answers describe capabilities not currently provided:

“Awareness of privacy, transparency and clarifying aspects of legal responsibility and accountability with continuous training and acquiring skills according to developments in the field.”

(GO-1)

“Training should focus on ethical decision-making, data handling, and understanding AI limitations in clinical contexts.”

(GO-4)

“To improve ethical awareness in the field of AI, I believe training needs to go beyond just technical skills and focus on real-world implications. Workshops and courses on topics like bias in algorithms, data privacy, and ethical decision-making should be a core part of the curriculum. Case studies and simulations can be particularly effective, as they help people understand the consequences of AI in sensitive areas like healthcare.”

(AC-4)

“Training in areas like ethical decision-making, data governance, and AI-specific case law is essential.”

(AC-1)

“More workshops, more educational materials via conferences, hospital media committees etc.”

(GO-6)

“1. AI Workshops and lectures. 2. Interdisciplinary Collaboration Training: Sessions that bring together clinicians and statistician and IT to address ethical challenges from multiple perspectives. 3. Regulatory and Policy Education.”

(AC-3)

Across these accounts, training provision is voluntary, episodic, and organised around events rather than competencies. Conferences and workshops recur as the principal mechanism, and attendance rests on individual initiative. No respondent described a mandatory AI ethics component attached to professional registration, appointment, or continuing professional development, and none described any assessment of AI ethics competence. Two respondents recommended that mandatory training be introduced (AC-1, AC-3). One industry respondent read this as a structural constraint on the spread of ethical awareness rather than a shortfall of individual effort (IN-5; quoted in the AI Ethical Gaps in Curriculum and Educational Integration section).

AI Ethical Gaps in Curriculum and Educational Integration

AI ethical gaps in curriculum and educational integration refer to the absence of a unified, mandatory, or comprehensive curriculum in academic institutions teaching how to identify, assess, and mitigate the ethical risks of AI systems. This sub-theme was coded in the interviews of all 20 respondents (468 references), which makes it the most extensively discussed element of the analysis. Government and academic respondents alike treated curricular integration as the principal means of establishing ethical understanding:

"Integrating ethical principles into the curriculum of students in medical and health colleges, as well as training healthcare workers. Incorporating these principles into the accreditation systems for healthcare institutions. Conducting continuous evaluations of practices in healthcare institutions and among their staff, and taking appropriate actions."

(GO-2)

"Awareness, train and qualify students, whether in schools, colleges or universities, to integrate AI ethics and be continuously evaluated in light of digital transformation."

(GO-5)

"1. Incorporating AI technology curricula in medical schools and related specialties. 2. Conducting interdisciplinary research on AI applications and implications. 3. Organizing workshops to raise awareness and build skills. 4. Collaborating with policymakers to establish robust AI governance frameworks."

(AC-3)

"Academic institutions play a key role in helping students understand the ethical side of using AI in healthcare. They can include courses that combine technology, healthcare, and ethics, so students learn how to apply AI responsibly in real-world situations. In addition, academic institutions should host workshops and discussions about real-life challenges that can encourage critical thinking and open conversations about ethical dilemmas."

(AC-4)

"Academic institutions can establish dedicated ethics committees, collaborate with policymakers to develop guidelines, and offer interdisciplinary programs on AI ethics."

(AC-1)

Asked which topics should receive greater emphasis in academic programmes, three respondents named an overlapping set built around bias, privacy, and accountability, while a fourth named a different pair:

"Topics include data privacy, bias in AI algorithms, informed consent, and accountability in AI-driven decisions."

(AC-1)

"I think academic programs should put more emphasis on topics like bias in AI algorithms, data privacy, and the accountability of AI-driven decisions in healthcare. These are critical issues that often don't get enough attention, even though they have a huge impact on patient safety and trust."

(AC-4)

"1. Bias 2. Transparency and Accountability 3. Data Privacy and Security."

(AC-3)

"Privacy and Intellectual Property."

(AC-2)

Accounts of what is currently in place were more limited. One government respondent described provision as being at the point of introduction rather than established, while an industry respondent characterised the current level of integration as a constraint:

"Awareness campaigns, dedicated training sessions, and AI ethics modules in healthcare curricula are currently being introduced."

(GO-4)

"Limited integration of AI ethics into mainstream education and professional training restricts the broader dissemination of this awareness."

(IN-5)

Two observations follow. First, respondents were markedly more articulate about what curricula should contain than about what they do contain. Prescriptive accounts were detailed and, with one exception, converged on the same core set of topics, whereas descriptive accounts of existing provision were brief and, in the one case where provision was reported (GO-4), qualified as still being introduced. Second, the topics respondents identified for curricular inclusion, bias in algorithms, accountability for AI-driven decisions, transparency, and data governance, correspond closely to the concepts that appeared unevenly in their own accounts of current ethical awareness (the Fragmented and Inconsistent AI Ethical Awareness section). Respondents were, in effect, prescribing instruction in precisely those concepts their own answers showed to be inconsistently held. The curricular gap and the awareness gap describe one deficiency observed at two points: what is absent from professional education matches what is uneven in professional understanding.

Discussion

Awareness as Conceptual Rather Than Critical

The respondents in the Sultanate of Oman understood what AI could contribute to the provision of healthcare. They did however not have as high a level of ethical awareness about this. In addition to privacy and data security there are several other ethical issues mentioned most consistently in relation to AI. These include the risk of discrimination through algorithms (algorithmic bias), transparency, accountability and the need to retain human oversight in clinical decision making. Previous studies have reported the same combinations of potential benefits and risks associated with the use of AI in healthcare (Alsaedi et al., 2025; Weiner et al., 2025).

The main difference from previous studies is the depth at which that recognition operates. While many respondents pointed out general ethical considerations very few described how they would be implemented. Only four of the twenty records referred to explainability, that is, openness to scrutiny of an algorithmic recommendation. Two of the four were industry respondents. Weidener and Fischer (2024) report the same gap between exposure to AI technologies and formal education in AI ethics, and Alsaedi et al. (2025) observe professionals willing to adopt AI while reporting insufficient skills and limited ethical preparedness. In summary it seems that awareness of AI in Omani healthcare systems exists on a general/conceptual level rather than at a critically informed level. This difference has practical implications. General/conceptual awareness is sufficient to endorse an ethical principle. However, it is not sufficient to implement this principle when a specific system produces a controversial result.

Why Awareness Clusters Around Privacy

the Fragmented and Inconsistent AI Ethical Awareness section reports a graded distribution of ethical concepts across the interview records. All twenty of the interview records included discussion of privacy; approximately two-thirds contained discussion of bias, transparency, and accountability; four included discussions of explainability; and there were no references to auditability. The gradient persisted among the ten respondents whose interview guide made no reference to any of these concepts. Therefore, it is worthwhile to explore, instead of just documenting, this gradient since the concepts at the thinner end of the spectrum do not appear to be less relevant in clinical practice than the concepts at the thicker end.

An explanation consistent with the second major theme in this study is that professionals focus ethically based on the availability of vocabulary within their institutions. Using Scott's (2014) terminology, both privacy and data protection have an established regulative pillar. The Personal Data Protection Law, Royal Decree No. 6/2022 (Sultanate of Oman, 2022), provided a basis for governing personal data in Oman at the time of this research. Medical records are typically governed through legal and administrative vocabularies for confidentiality. These same vocabularies can be easily extended to AI. There were no similar instruments available that addressed algorithmic fairness, auditability, or explainability. Additionally, there were no similar local anchors for these concepts. Respondents indicated that there were no forums, committees, guidelines, or courses where professionals could become familiar with these concepts and apply them. That is, there were no regulatory rules from which normative expectations and a shared cultural-cognitive schema could emerge. The gradient therefore represents the extent to which professional use of vocabulary for each concept is supported by institutional scaffolding for identifying each concept, not how important each concept is in relation to risk. Therefore, the gradient explains why the only concept with a statute was mentioned in every record, while the only concept without either a statute or curriculum was never discussed.

Moral Sensitivity as an Institutionally Conditioned Capacity

Rest's (1986) concept of moral sensitivity, the recognition that a situation carries ethical implications, offers one way to read the findings. Levels of such recognition differed markedly. Some respondents discussed patient autonomy, algorithmic bias, and confidentiality critically. Others treated AI integration mainly as a route to technological efficiency and reflected little on its ethical implications. Fig. 2 sets out the integrated framework used to interpret that variation.

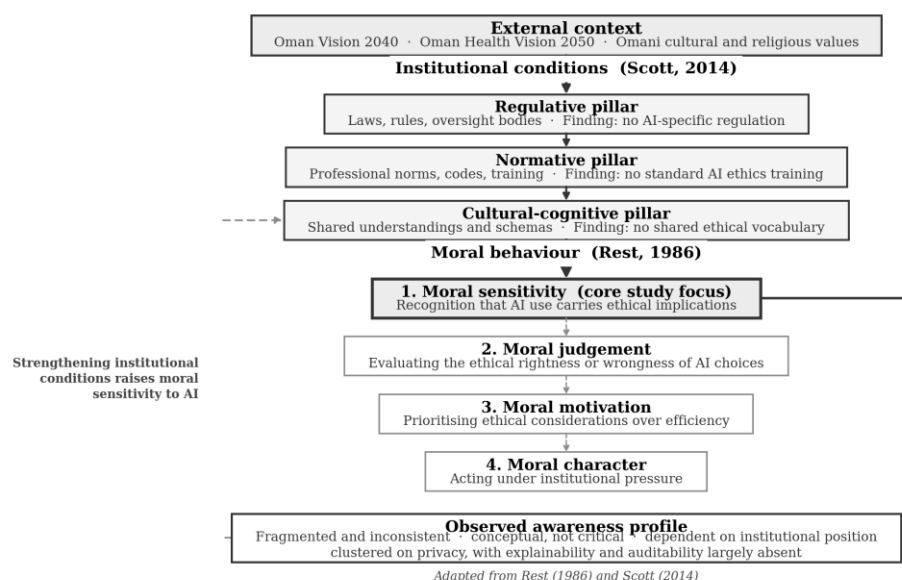


Fig. 2. Integrated framework: institutional conditions (Scott, 2014) and moral sensitivity to AI ethics (Rest, 1986) in Oman's healthcare system

The pattern of that variation is theoretically informative. Rest's model treats moral sensitivity largely as an individual attribute developed through moral education and experience. On that reading, the differences observed here would follow from differences in ethical commitment

or personal development. Three features of the data resist it. First, among the ten respondents who received the awareness question in identical wording, assessments ran from “very low” (GO-6) to descriptions of medical staff awareness as “good” (NGO-2) and of ethical concerns as “widely discussed” (NGO-3). Respondents answering the same question about the same health system did not converge. Second, the one concept that presupposes proximity to system design, explainability, was raised by two of the five industry respondents but by only two of the remaining fifteen. Recognition of it tracked institutional position rather than any measure of individual ethical commitment. Third, the sub-theme discussed by every respondent and coded most extensively across the dataset concerned the absence of curricula and training, not a deficit of individual moral concern.

Scott’s (2014) three pillars account for this pattern in a way Rest’s model alone does not. Respondents described the regulative pillar as largely absent for AI within healthcare. No respondent identified rules, guidelines, or oversight bodies governing its ethical use in a healthcare institution, although two industry respondents reported ethics committees forming within the technology sector (the Lack of Formal Institutional Dialogue section). Without formal rules, the normative pillar could not develop. Respondents reported no mandatory training, no professional expectation that AI ethics form part of competent practice, and no shared standard against which conduct could be assessed. Lacking both regulative rules and normative expectations, the cultural-cognitive pillar supplied no interpretive schema through which the ethical features of AI could be recognised at all. AC-4 observed that “many users, I believe, use AI disregarding the ethics of using, adopting, or implementing AI”, and AC-2 described colleagues who “are aware of the potential of AI but are yet to realize the importance of ethical implications, such as bias and privacy”. Familiarity with the technology had developed without a corresponding vocabulary for its ethical dimensions. The chain runs in one direction. An absent regulative foundation constrains normative development, which constrains the shared understandings on which recognition depends. Moral sensitivity is the downstream outcome of that sequence.

In the context of AI, then, moral sensitivity may be better understood as a capacity that institutions distribute than as one individuals simply possess. The theoretical contribution of this study lies in that specification. It extends Rest’s model by identifying institutional preconditions for its first component, and it extends Scott’s framework by showing that the three pillars bear not only on organisational conduct but on individual ethical perception. Neither framework alone accounts for the findings. Rest identifies what varies; Scott explains why. The integration is derived from a non-Western healthcare setting in which the relevant institutional infrastructure is still being established, rather than imposed upon it.

The practical implication follows directly, and it differs from what a purely individual account would suggest. If ethical recognition depends on institutional scaffolding, interventions aimed at raising awareness of AI ethics should target that scaffolding rather than rely on professional conscientiousness. The measures respondents themselves proposed map onto it: curricular integration (GO-2, GO-5, AC-1, AC-3, AC-4, AC-5), dedicated ethics committees (AC-1), interdisciplinary training that brings clinicians, statisticians and IT staff together (AC-3), and explicit legislative provision, whose absence was noted by AC-4 and NGO-1. The sequence also indicates an order of priority. Regulative measures are the enabling condition

for the normative and cultural-cognitive change on which sustained ethical awareness depends.

Benchmarking Against Regional and International Evidence

Setting these findings side by side with evidence from comparable settings shows what is general to other countries and what is unique about Oman. Concern over fairness, transparency, and responsibility has been shared among physicians and nurses in Saudi Arabia (Alsaedi et al., 2025). Lack of clarity on legal liability and decision-making authority also parallels earlier Gulf studies among physicians and medical students (AlZaabi et al., 2023). Reservations over privacy and trust have also been documented in public attitudes in the United Arab Emirates (Jarab et al., 2025); limited familiarity combined with a recognised need for governance frameworks have also been reported among hospital staff in Costa Rica (Zavaleta-Monestel et al., 2025). The disconnect between rising exposure to artificial intelligence and absent formal ethics education has been documented among medical students (Weidener & Fischer, 2024) as well as in reviews of nursing practice across Arab countries (Ibrahim et al., 2025). Ethical uncertainty over artificial intelligence implementation is not unique to Oman. It represents a broader challenge in the digital transformation of healthcare.

The Omani case has two important distinguishing characteristics. The first is the level of concern expressed by respondents. Respondents did not express concerns based on their own uncertainty about what to do or whether to use an AI system. Rather, they expressed concerns based on the lack of appropriate institutional structures for addressing these issues, such as committees, guidelines, curricula, and dialogue mechanisms. The second is the relationship that was established between AI ethics and both trust and professional accountability. Trust and professional accountability were each identified in twelve of the twenty records. Additionally, three additional records referenced the need to maintain some level of human oversight over clinical decisions. Specifically, GO-3 held that “the final decision should often rest with the physician rather than AI alone”. This perspective could possibly relate to the fact that clinical practice in Oman is highly relational and focuses on interpersonal communication and professional responsibility. However, this hypothesis cannot be tested using the available data. When viewed together, the two characteristics indicate that in early stages of adopting AI into healthcare systems, the deficiency in governance will come before it does so for competence. Other research also indicates that successful AI implementation is dependent upon strong governance frameworks and ethical mechanisms in addition to having technological capability (Rosemann & Zhang, 2022; Mennella et al., 2024).

Implications for Policy and Practice

Three conclusions follow from the findings

The most strongly supported conclusion based upon the data is that ethics for artificial intelligence should be integrated into continuing professional development and curriculum for health professionals. This was the element discussed by every respondent and coded most extensively across the dataset. Both government and academic respondents came up with this idea independently. Government officials suggested that the government include ethical standards into the curricula of medical and health schools and through accreditation processes (GO-2; GO-5) while academic respondents suggested integrating technology and

healthcare with ethics courses (AC-3; AC-4; AC-5). Conversely, one industry respondent identified an additional reason why ethical consciousness has been limited, attributing it to the weak integration of AI ethics into mainstream education and professional training (IN-5). Curricular integration also carries the longest lead time, which argues for early rather than sequenced action.

As a second implication, institutions require ongoing mechanisms through which AI ethics may be considered before adverse events occur. Respondents characterised their experience with ethics as reactive and case-by-case. They stated that there are no specific forums, committees, or regulatory agencies responsible for addressing AI ethics issues. Two respondents provided details concerning what these mechanisms might look like. AC-1 recommended “establishing national AI ethics committees” together with mandatory ethical training and a requirement that “AI systems undergo ethical review before deployment”. NGO-1 recommended “dedicated communication channels, AI ethics committees, and periodic surveys” as a means to report ethical concerns.

Third, training should shift from general awareness towards the ability to apply ethical reasoning in practice. Respondents were specific about the content, naming bias in algorithms, data privacy, and ethical decision-making. They stated that these issues can best be taught using case studies and simulations that convey “the consequences of AI in sensitive areas like healthcare” (AC-4). In particular, respondents identified ethical decision-making, data governance and AI-specific case law (AC-1) and also mentioned interdisciplinary sessions where clinicians, statisticians and IT staff would work collaboratively to identify and discuss ethical challenges from multiple viewpoints (AC-3). Existing provision was described differently, as conferences, seminars and workshops (GO-1, IN-2). Such provision is attendance-based rather than competency-based.

Study Scope And Limitations

The first limitation concerns the fact that this study is organisational in nature and was completed within a policy cycle; as such, it assessed institutional readiness, needs, and the anticipated implementation of AI ethics governance rather than user experience of frontline clinical services. Institutional leaders, policy officials, and senior clinicians were interviewed. Nurses, allied health practitioners, healthcare administrative staff, patients, and service users were not. Thus, the results describe ethical awareness as it is formed at institutional level rather than at the point of care.

The second limitation refers to the fact that the sample selection was purposeful (purposive sampling) and snowballing methods were used. Twenty respondents were interviewed in a single country. This number of respondents provided sufficient information regarding achieving thematic saturation concerning the original research question, thus supporting analytic generalisation over statistical generalisation.

The third limitation pertains to the methodological approach taken by relying on self-report of awareness. Stating that an ethical matter is important does not establish that appropriate practices follow. Social desirability bias may also be present among respondents due to their institutional position. Coding of all data collected was performed by a single researcher. The coder’s decisions were documented in NVivo. The full thematic analysis can be found in

Appendix A; however, there was no independent coding validation, nor were preliminary themes returned to respondents to validate their accuracy.

Fourth, the interviews are documented with coded answers for each item on the interview guide, as opposed to continuous verbatim transcripts of what was said during the conversation. The coded answer format supports reliable attribution, and every quotation reported above was checked against its source record. However, the coding does not capture the order in which the conversation took place or whether the questions asked by the interviewer were followed in a particular way. This means that the counts in the Fragmented and Inconsistent AI Ethical Awareness section record the vocabulary available to respondents rather than their understanding of those concepts. The section on why awareness clusters around privacy uses the counts in that sense. Appendix C lists, by item, each element of COREQ reporting that could not be established from the study records. Included are the length of time spent interviewing, where the interview was conducted, and what qualities/characteristics the interviewer possessed.

Fifth, there exists contradictory information in the data. While two respondents working in industry mentioned formation of ethics committees and review mechanisms, none of the respondents mentioned similar processes occurring at institutions providing healthcare. The conclusion drawn here is bounded accordingly, and five industry respondents cannot establish how far such arrangements extend.

Conclusion

This study investigated what healthcare professionals and stakeholders in Oman's healthcare system know about the ethics of AI, and why that knowledge varies. Respondents were aware of what AI can do to enhance efficiency, diagnosis, and decision making, but their levels of ethical awareness and conceptual understanding varied. Privacy was mentioned in every interview record; bias, transparency, and accountability in roughly two-thirds; explainability in four records; and auditability in none. The gradient continued among respondents whose interview guide referenced none of these concepts, so it is not an artefact of the questions asked.

In terms of Rest's four-component model, that awareness is moral sensitivity, the component on which the remaining three depend. In terms of Scott's institutional theory, its distribution tracked institutional position rather than individual ethical commitment. When no regulative rule exists for any category of AI risk, then professional norms have nothing to consolidate around and the shared understandings that make an ethical feature recognisable do not form. On this reading the governance deficit precedes the competence deficit rather than follows from it.

The contribution of the study is to treat ethical literacy, governance frameworks and professional preparedness as one issue rather than separate issues. Three lines of work follow: sampling frontline point-of-care staff, including nurses and allied health professionals, across several institutions and stakeholder groups; testing rather than assuming the relationship between AI training, ethical decision-making, and organisational readiness; and comparative work across GCC countries to determine how much of the pattern is Omani and how much regional.

Declarations

Conflicts of interest. The authors declare no conflicts of interest.

Informed consent. Written informed consent was obtained from all respondents before the interview. Participation was voluntary, respondents were free to withdraw at any point and to decline any individual question, and consent to audio recording was obtained separately.

Data availability. The interview records are not publicly available so as to protect the confidentiality of respondents, several of whom hold identifiable institutional positions. Anonymised extracts may be made available by the authors on reasonable request.

APPENDIX A. Thematic structure and coding coverage

The table below sets out the thematic structure derived for the research question addressed in this paper, together with the working definition applied during coding and the coverage generated by NVivo. Respondents denotes the number of interviews containing material coded to the node; references denotes the total number of coded segments.

Level	Theme / sub-theme	Working definition	Respondents	References
Overarching	AI ethical awareness among professionals and stakeholders	Recognition and interpretation of the ethical considerations arising from the use of AI in the healthcare system.	20	984
Theme 1	Limited awareness of AI ethics among professionals	Insufficient understanding, recognition, or consideration of the moral, security, and societal risks associated with the development, deployment, and integration of AI technologies.	20	379
Sub-theme 1.1	Fragmented and inconsistent AI ethical awareness	A situation in which institutions hold disjointed, incomplete, or divergent levels of understanding of ethical issues, leading to inconsistent ethical decisions.	19	274
Sub-theme 1.2	Lack of formal institutional dialogue on the ethics of AI	The absence of organised, standardised, and binding mechanisms within institutions to discuss, evaluate, and act upon the ethical risks posed by the use of AI.	19	105

Level	Theme / sub-theme	Working definition	Respondents	References
Theme 2	AI ethics literacy gaps	The distance between the level of ethical understanding required for responsible AI use and the current levels of knowledge and skill available to apply it.	20	605
Sub-theme 2.1	Absence of standard training in AI ethics	The lack of consistent, formal, and widely adopted training provision addressing the ethical implications, risks, and responsible use of AI systems.	19	137
Sub-theme 2.2	AI ethical gaps in curriculum and educational integration	The absence of a unified, mandatory, or comprehensive curriculum in academic institutions teaching how to identify, assess, and mitigate the ethical risks associated with AI systems.	20	468

APPENDIX B. Interview guide

The interview guide was tailored to each stakeholder category. The questions below are reproduced from the interview records. Interviews were semi-structured, and follow-up questions were asked where a response invited elaboration.

Government officials

1. What key challenges has the government encountered in adapting AI technologies within the healthcare system?
2. What do you see as the primary challenges to the successful adaptation of AI technologies in the healthcare system?
3. Is there any AI policy in place in Oman for healthcare?
4. What challenges do you perceive related to data privacy and security when implementing AI in the healthcare system?
5. How aware are you of the ethical challenges associated with the use of AI in the healthcare system?
6. What ethical issues related to AI in healthcare do you consider most pressing?
7. What steps are being taken at the policy level to ensure that ethical considerations are integrated into AI applications in healthcare?
8. How do you assess the current policies related to the ethical use of AI in healthcare?
9. What role do you think policymakers should play in promoting AI ethics in healthcare system?
10. What measures are in place to ensure ethical compliance in the use of AI within the healthcare system?

11. What strategies is the government implementing to ensure ethical considerations in the adoption of AI in Oman's healthcare system?
12. What best practices would you recommend for integrating ethics into AI adoption for healthcare system?
13. What educational initiatives are in place to increase awareness of integrating ethics in AI among healthcare professionals and policymakers?
14. What training do you believe are necessary to improve AI ethics in healthcare?
15. How do you evaluate the effectiveness of training programs for AI ethics in healthcare?
16. What recommendations would you suggest to strengthen the integration of ethics in AI within the healthcare system?

Academic scholars

1. Have you conducted any studies or research projects that focus on the adoption of AI in healthcare system?
2. In your research, what key challenges have you identified in adopting AI for the healthcare sector?
3. What cultural challenges have you seen that hinder the adaptation of AI within healthcare sector in Oman?
4. In your opinion, how significant are the barriers to the successful implementation of AI in healthcare?
5. How prepared are healthcare professionals to use AI in the healthcare system?
6. How do you perceive the current state of ethical awareness regarding AI?
7. How can academicians contribute to fostering the awareness of AI ethics in healthcare?
8. How can academic institutions contribute to promoting ethical understanding of AI technologies in healthcare?
9. How often do you incorporate discussions of ethics in AI into your research or teaching related to healthcare?
10. How do you assess the level of understanding of ethical issues in AI among your colleagues?
11. How do you stay updated on ethical standards and practices related to AI in healthcare?
12. What topics related to ethics in AI do you think should be emphasized more in academic programs?
13. What role do you think academia should play in promoting AI ethics?
14. What training do you believe are necessary to improve ethical awareness in this field?
15. In what ways do you think ethical training impacts the implementation of AI technologies?
16. Are you aware of any established ethical guidelines for integrating ethics in AI within healthcare sector?
17. From your opinion, what guidelines should be followed to integrate ethics in AI within the healthcare system in Oman?
18. What recommendations would you suggest to strengthen the integration of ethics in AI within the healthcare system?

Industry experts

1. What key challenges have industries faced in providing AI technologies for the healthcare sector in Oman?

2. What challenges do you perceive related to data privacy and security when providing AI technologies for the healthcare sector in Oman?
3. To what extent might these ethical issues impact the adoption of AI in the healthcare system?
4. To what extent are the industries aware of the ethical challenges in the adoption of AI in the healthcare system?
5. What ethical issues related to AI in healthcare do industries consider most pressing?
6. How do industries ensure that ethical principles are integrated into the AI technologies used in Oman's healthcare system?
7. What role do you think industries should play in promoting AI ethics in healthcare system?
8. What measures do industries have in place to ensure ethical compliance in the use of AI within the healthcare system?
9. From your perspective, what strategies are the industries implementing to ensure ethical considerations in the development of AI in Oman's healthcare system?
10. What best practices would you recommend for integrating ethics into AI development for healthcare system?
11. What industry programs are in place to raise ethical awareness in developing AI for healthcare?
12. How do relevant industries collaborate with policymakers to facilitate the ethical integration of AI into Oman's healthcare system?
13. What recommendations would you suggest to strengthen the integration of ethics in AI within the healthcare system?

Non-governmental organisations

1. How familiar are you with the use of AI technologies?
2. What is your opinion of AI's role in improving healthcare services?
3. What concerns do you have about the use of AI in healthcare?
4. In your opinion, how significant are the barriers to the successful implementation of AI in healthcare?
5. How does the public view the readiness of healthcare industries to adopt AI in healthcare system?
6. How do you perceive the current state of ethical awareness regarding AI?
7. To what extent the public are aware of ethics in AI?
8. How aware are you of the ethical challenges associated with the use of AI?
9. What ethical issues do you think arise from the use of AI in healthcare?
10. What ethical issues do you think arise in determining responsibility for medical errors arising from the use of AI: does responsibility lie with the institution or the developer?
11. How informed do you feel about the ethical implications of AI in healthcare?
12. How familiar are you with the ethical guidelines that govern the use of AI in healthcare?
13. What resources would help you better understand the ethics of AI in healthcare?
14. What role can civil society play in ensuring the ethical use of AI within the healthcare system?
15. How important is public engagement on discussions about the ethical use of AI in healthcare?
16. What training program you need for better understanding of ethics in AI?
17. What methods do you think would be effective for fostering public dialogue on this issue?

18. How should feedback from the public be incorporated into the implementation of ethical guidelines for AI in healthcare?
19. What mechanisms would you suggest for reporting ethical concerns related to AI use in healthcare?
20. What recommendations would you suggest to strengthen the integration of ethics in AI within the healthcare system?

APPENDIX C. COREQ (32-item) checklist

Completed against the present manuscript. Items marked as not reported are acknowledged gaps rather than omissions from the reporting of available information.

No.	Item	Status and location in the manuscript
	Domain 1: Research team and reflexivity	
1	Interviewer / facilitator	Not reported
2	Credentials	Not reported
3	Occupation	Partially reported — the Sampling and Respondents section and the Data Collection section
4	Gender	Not reported
5	Experience and training	Not reported
6	Relationship established prior to study	Not reported
7	Participant knowledge of the interviewer	Not reported
8	Interviewer characteristics	Not reported
	Domain 2: Study design	
9	Methodological orientation and theory	Reported — the Theoretical Framework section, 3.1, 3.4
10	Sampling	Reported — the Sampling and Respondents section (purposive and snowball; quadruple-helix model)
11	Method of approach	Reported — the Sampling and Respondents section (purposive with snowball referral)
12	Sample size	Reported — the Sampling and Respondents section and Table 1 (N = 20)
13	Non-participation	Not reported
14	Setting of data collection	Partially reported — the Data Collection section (pilot conducted at respondents' places of employment)
15	Presence of non-participants	Not reported
16	Description of sample	Reported — Table 1
17	Interview guide	Reported — Appendix B
18	Repeat interviews	Not reported

No.	Item	Status and location in the manuscript
19	Audio / visual recording	Reported — the Ethical Considerations section (consent to audio recording obtained from all respondents)
20	Field notes	Not reported
21	Duration	Not reported
22	Data saturation	Reported — the Data Collection section
23	Transcripts returned to respondents	Not reported
	Domain 3: Analysis and findings	
24	Number of data coders	Reported — the Study Scope and Limitations section (single coder)
25	Description of the coding tree	Reported — the Data Analysis section, Table 2 and Appendix A
26	Derivation of themes	Reported — the Data Analysis section (inductive)
27	Software	Reported — the Data Analysis section (NVivo 15)
28	Participant checking	Not reported — see the Study Scope and Limitations section, Study Scope and Limitations
29	Quotations presented	Reported — the Limited Awareness of AI Ethics section and the AI Ethics Literacy Gaps section; each quotation verbatim from one respondent, identified by code
30	Data and findings consistent	Reported — the Results and the Discussion
31	Clarity of major themes	Reported — the Limited Awareness of AI Ethics section and the AI Ethics Literacy Gaps section, Figure 1, Table 2
32	Clarity of minor themes	Reported — the Fragmented and Inconsistent AI Ethical Awareness section to 4.2.2

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