

RESEARCH

Open Access



Health sciences students' attitudes toward artificial intelligence: predictors of ethical awareness, clinical decision-making, and public health perceptions-a cross-sectional study

Cihan Unal^{1*} and Selim Şahin¹

Abstract

This study investigates health sciences students' attitudes toward artificial intelligence (AI) and the implications for ethical awareness, clinical decision-making, and public health. A cross-sectional survey was conducted between April 27 and May 15 2025, with 668 students from five departments at Gümüşhane University, employing the validated Artificial Intelligence Attitude Scale, which measures benefits, risks, and use, alongside 12 binary-response items assessing ethical, clinical, and public health judgments. Descriptive statistics, t-tests, ANOVA, and logistic regression analyses were applied. Findings indicate that students perceive AI as highly beneficial ($M=4.05$) but also associate it with notable risks ($M=2.52$; where lower scores indicate a higher level of perceived risk due to reverse coding). Logistic regression analyses revealed that risk perception (reverse-coded; higher scores indicating lower perceived risk) was the most consistent predictor across all dimensions. Specifically, students with lower perceived risk were significantly more likely to reject concerns regarding patient privacy ($OR=2.55$, 95% CI [2.03–3.21], $p<0.001$), dismiss the idea that relying on AI instead of human expertise is problematic ($OR=1.57$, 95% CI [1.25–1.96], $p<0.001$), and reject the notion that AI systems may harm public health ($OR=2.52$, 95% CI [1.98–3.20], $p<0.001$). While participants endorsed AI's potential in enhancing patient safety, chronic disease management, and preventive care, they expressed significant concerns about privacy, legal responsibility, and a potential weakening of patient–clinician communication. Gender, academic discipline, and prior AI use further differentiated attitudes. The results highlight a dual perception of AI as both an opportunity and a threat, emphasizing that successful integration in healthcare requires not only technical competence but also ethical, legal, and communicative safeguards.

Keywords Artificial intelligence, Health sciences students, Ethics, Clinical Decision-Making, Public health

*Correspondence:

Cihan Unal
chnun13@gmail.com

¹Department of Healthcare Management, Gümüşhane University,
Gümüşhane, Türkiye



© The Author(s) 2026. **Open Access** This article is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License, which permits any non-commercial use, sharing, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if you modified the licensed material. You do not have permission under this licence to share adapted material derived from this article or parts of it. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by-nc-nd/4.0/>.

Background

Artificial intelligence (AI) is revolutionizing healthcare by improving diagnostic accuracy, supporting treatment decisions, and enhancing efficiency in preventive healthcare [1, 2]. However, this rapid integration has brought with it both optimism and concerns. While AI offers unique opportunities to assist clinical decision-making and elevate health outcomes, it also provokes significant ethical dilemmas, including concerns surrounding data privacy, professional accountability, and the potential erosion of the human aspect of healthcare [3, 4]. This opportunity–risk dichotomy lies at the core of international discussions regarding the future trajectory of medicine and healthcare [5].

In the context of health pedagogy, the significance of preparing future practitioners to navigate these opportunities and challenges is increasingly important. Contemporary investigations indicate that learners possess generally positive attitudes towards AI, specifically highlighting its potential to enhance diagnostic precision and reduce diagnostic errors [1, 6]. Nevertheless, the loss of empathy, commercialization of care, and uncertainties regarding ethical and legal responsibilities also rank among the commonly expressed concerns [7, 8]. Supporting these findings, recent evidence from both nursing students and ICU professionals, specifically highlighting that while AI awareness may initially heighten anxiety, practical experience tends to mitigate these worries, underscores a strong willingness to engage with AI technologies despite significant concerns regarding data privacy, hacking, and the potential depersonalization of human-centered care [9–11].

However, much of the literature addresses students' perceptions of AI only at a general level, focusing primarily on general attitudes, literacy, or awareness, without systematically relating these perceptions to dimensions of ethical awareness, clinical decision-making, and public health.

This gap is especially important to address. As healthcare evolves to become progressively digital, future practitioners will not only use AI as a tool, but will also be required to assess its impact on patient autonomy, professional accountability, and equitable access to healthcare [12, 13]. The Technology Acceptance Model (TAM) and Unified Theory of Acceptance and Use of Technology (UTAUT) postulate that perceived usefulness, risk, and ease of use are pivotal in shaping behavioral intentions [14, 15]. To this point, however, few empirical studies have examined these theoretical constructs in health sciences students by directly linking these frameworks to ethical consciousness, clinical accountability, and public health perspectives. In this framework, addressing the identified gap is essential to anticipate how AI will be integrated into health systems, and to develop

educational interventions that incorporate ethical considerations in addition to technical proficiency.

This study aims to address this gap and to examine the attitudes of health science students toward AI from a multidimensional perspective. Specifically, it investigates how perceptions of benefits, risks, and usage predict ethical awareness (e.g., data confidentiality, professional accountability), clinical decision-making (e.g., patient safety, sharing of responsibility), and public health (e.g., preventive health services, communication). Based on 12 items analyzed using logistic regression, this study presents a comprehensive and predictive model for the determinants that shape students' attitudes toward AI. In doing so, it extends beyond purely descriptive approaches in the existing literature, offering a more explanatory framework and providing novel insights into how future health professionals will reconcile technological innovations with human-centered values.

Conceptual framework of the study

This study is theoretically grounded in the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT), which posit that technology-related professional attitudes are shaped by a combination of individual perceptions and contextual factors. In our conceptual model, as illustrated in Fig. 1, we identify two primary groups of predictors:

1. Attitudinal Factors, comprising Perceived Benefits, Perceived Risks, and AI Use tendency as measured by the Artificial Intelligence Attitude Scale; and
2. Socio-Demographic and Experiential Factors, including gender, age, department, academic year, and current AI usage status. These independent variables are theorized to predict 12 distinct outcomes representing three professional domains: Ethical Awareness, Clinical Decision-Making, and Public Health Perceptions. Following the principles of TAM and UTAUT, we hypothesize that while perceived benefits and prior experience facilitate professional acceptance, perceived risks function as a critical barrier that dictates ethical and accountability-related concerns in healthcare.

Methods

Population and sample

The population of this study consists of students enrolled in the Faculty of Health Sciences at Gümüşhane University, Republic of Türkiye. The research included five departments: Emergency Aid and Disaster Management (EADM), Healthcare Management, Nutrition and Dietetics, Social Work, and Nursing. According to data obtained from the Gümüşhane University Directorate of

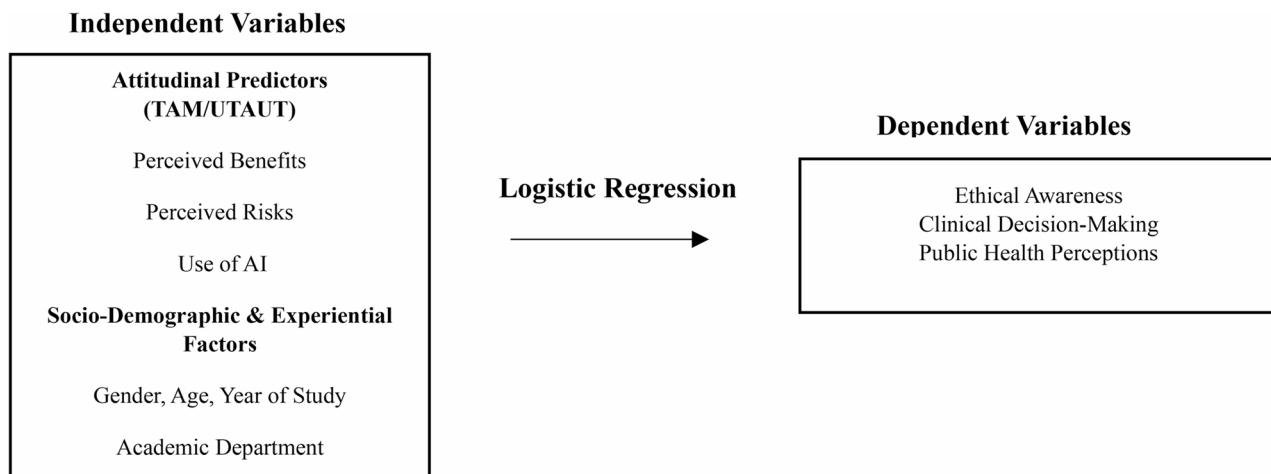


Fig. 1 Conceptual research model of the study

Student Affairs, the total number of students enrolled in these five departments was 1,985.

The minimum sample size to be drawn from the population was calculated using the formula $n = N \cdot t^2 pq / [d^2(N-1) + t^2 pq]$. Based on this formula, assuming a 99% confidence level ($\alpha = 0.01$) and $p = 0.5$, the minimum required sample size was determined to be 498. Data collection was conducted between April 27 and May 15, 2025. The researchers employed a convenience sampling method, visiting classrooms face-to-face to inform students about the study objectives prior to their lectures. Hard-copy questionnaires were distributed physically to a total of 794 students who were present in the classrooms. The eligibility criteria included being an enrolled student in the Faculty of Health Sciences and volunteering to participate. Of the 794 students approached, 689 returned the survey; however, 21 of them returned incomplete questionnaires and were excluded from the study. Missing data were managed using the listwise deletion method, ensuring that only participants with complete datasets were included in the final statistical analyses. Accordingly, a total of 668 students took part, constituting the final sample.

Data collection instrument

Data were collected face-to-face using an instrument consisting of two sections. In the first section, the *Artificial Intelligence Attitude Scale* was employed to assess participants' attitudes toward AI [16]. This scale comprises 13 items organized on a five-point Likert-type format (1 = Strongly disagree, 5 = Strongly agree). It consists of three subdimensions: benefits of artificial intelligence (items 1–3), risks of artificial intelligence (items 4–7), and use of artificial intelligence (items 8–13). Since items 4, 5, 6, and 7 are negatively worded, they were reverse-coded during analysis.

In the second section of the data collection instrument, 12 closed-ended questions were included to assess participants' levels of ethical awareness, clinical decision-making, and perceptions related to public health. These questions were structured to be answered in a binary format ("yes" or "no"). The instrument was refined based on reviews by three healthcare management experts and a pilot test with 35 students, ensuring both content validity and readability prior to final administration. The primary reason for employing a binary (yes/no) response format for the 12 items related to ethical awareness, clinical decision-making, and public health was the absence of a pre-existing, validated scale that comprehensively addresses these specific research questions within a single instrument. Under these circumstances, binary items serve as robust tools to directly align with the research objectives and capture the definitive stances of participants. Furthermore, considering that data in social sciences frequently fail to satisfy normality assumptions, this categorical approach offers a significant methodological advantage; it allows for analysis that is independent of distributional constraints, thereby providing more resilient and interpretable outcomes through logistic regression modeling.

Additionally, five demographic questions were placed at the end of the form to obtain basic information about the participants, including gender, age, department, year of study, and their views on the use of AI applications in their profession.

Data analysis

The data obtained within the scope of the study were analyzed using the SPSS 25.0 statistical software package. In the first stage of the analysis, descriptive statistics (frequency and percentage distributions) were calculated for participants' demographic characteristics and their responses to the survey questions.

To assess the validity of the scale employed in the study, an exploratory factor analysis (EFA) was conducted using Principal Component Analysis with Varimax rotation, and Cronbach's alpha coefficient was calculated to determine its reliability.

To identify differences between groups, various comparative statistical tests were applied. Because the skewness and kurtosis values of the scale items and factors were within the ± 1 range, parametric tests were employed. Independent samples *t*-tests were used for comparisons between two groups, while one-way analysis of variance (ANOVA) was applied for variables with more than two groups (age group, department, and year of study).

In line with the main aim of the study, binary logistic regression analyses were conducted, employing the 'Enter' method, to examine the factors influencing students' ethical awareness, clinical decision-making, and public health perceptions. Accordingly, 12 separate models were constructed, each corresponding to a distinct dichotomous (yes/no) question treated as an independent outcome variable. The significance of individual predictors within the models was assessed using the Wald statistic ($p < 0.05$). The variance explained by each model was reported via Nagelkerke R^2 , while the associations were interpreted through Odds Ratios (OR) with 95% Confidence Intervals (CI) to provide a robust measure of both effect size and the precision of the estimates. To address the potential risk of Type I errors arising from multiple comparisons across the 12 independent models, the Benjamini–Hochberg False Discovery Rate (FDR) procedure was applied to all *p*-values. Under this correction, the dynamically adjusted significance thresholds for the models ranged from 0.0015 to 0.0500. All predictors originally identified as significant in the regression analyses remained statistically significant after the FDR adjustment, confirming the robustness and validity of the findings.

In each model, the dependent variable corresponded to the respective closed-ended question, while gender, age, department of study, year of study, AI use status, and the subdimensions of the Artificial Intelligence Attitude Scale (benefits, risks, and use of AI) were included as independent variables.

The goodness-of-fit of the logistic regression models was evaluated using the Omnibus Test and the Hosmer–Lemeshow Test. In this context, a significant Omnibus Test result ($p < 0.05$) and a non-significant Hosmer–Lemeshow Test result ($p > 0.05$) indicated that the model adequately fit the data and that the independent variables contributed meaningfully to the model.

To assess the risk of multicollinearity among the independent variables, Variance Inflation Factor (VIF) values

were examined. VIF values below 5 demonstrated the absence of multicollinearity issues.

Validity and reliability analyses of the data collection instrument

The reliability analysis of the Artificial Intelligence Attitude Scale used in the study yielded a Cronbach's alpha coefficient of 0.793, indicating acceptable internal consistency.

To assess construct validity, an exploratory factor analysis (EFA) was conducted. The analysis confirmed that the scale comprised three factors, consistent with its original version. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was 0.836, and Bartlett's test of sphericity was significant ($p < 0.05$). These findings indicated that the sample size was adequate and the data were suitable for factor analysis.

The factor analysis revealed that the scale explained a total variance of 61.1%. The variance explained by each factor was as follows:

- Factor 1 (*Benefits of Artificial Intelligence*): 32.411%.
- Factor 2 (*Risks of Artificial Intelligence*): 17.831%.
- Factor 3 (*Use of Artificial Intelligence*): 10.413%.

The eigenvalues of the factors were 4.213, 2.318, and 1.410, respectively. The factor loadings of the scale items ranged between 0.496 and 0.862.

Use of artificial intelligence

During the preparation of this work, the authors used OpenAI GPT-5 and DeepL Translate to improve language and readability. After using these tools, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

Results

Among the 668 health sciences students who participated in the study, 80.7% were female and 19.3% were male. In terms of age distribution, 37.0% of participants were 20 years old or younger, 23.4% were 21, 17.7% were 22, 12.0% were 23, and 10.0% were 24 years old.

In terms of departments, nursing students constituted the largest group 29.3%, followed by nutrition and dietetics (24.4%), social work (22.5%), healthcare management (15.0%), and emergency aid and disaster management (8.8%). The distribution across study years was relatively balanced: 28.3% were first-year, 29.6% second-year, 27.4% third-year, and 14.7% fourth-year students.

Furthermore, 79.2% of participants reported that they currently use or intend to use generative AI applications in their present or future professional practice. The demographic characteristics of the participants are presented in Fig. 2.

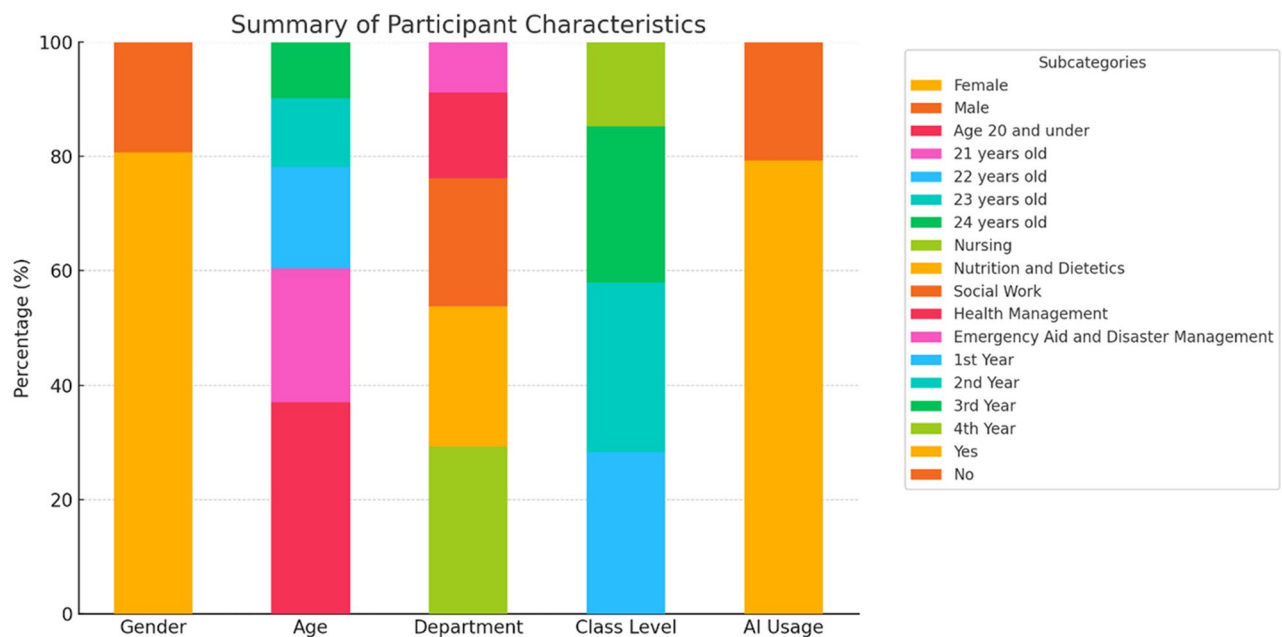


Fig. 2 Summary of participant characteristics

Table 1 Distribution of responses to AI-Related statements on ethical Awareness, clinical Decision-Making, and public health perceptions

Statement	Yes n (%)	No n (%)
1. AI poses serious risks to patient privacy	368 (55.1)	300 (44.9)
2. Existing legal regulations are sufficient	185 (27.7)	483 (72.3)
3. AI systems could enhance patient safety	470 (70.4)	198 (29.6)
4. Physicians should not be liable for AI errors	329 (49.3)	339 (50.7)
5. Developers should be responsible for mistakes	455 (68.1)	213 (31.9)
6. Physicians should maintain legal accountability	459 (68.7)	209 (31.3)
7. I can rely on AI recommendations in practice	291 (43.6)	377 (56.4)
8. Problematic to rely on AI over human expertise	509 (76.2)	159 (23.8)
9. AI can enhance preventive healthcare efficiency	503 (75.3)	165 (24.7)
10. AI-based systems might harm public health	302 (45.2)	366 (54.8)
11. AI is effective in chronic disease management	564 (84.4)	104 (15.6)
12. AI use may weaken provider-patient communication	488 (73.1)	180 (26.9)

As detailed in Table 1, participants evaluated various dimensions of ethical awareness, clinical decision-making, and public health. Regarding data privacy, the majority perceived significant risks and found current legal regulations insufficient. While AI was largely recognized for its potential to enhance patient safety, preventive care, and chronic disease management, opinions on legal liability were notably divided. Participants simultaneously attributed responsibility for errors to AI developers while maintaining that physicians should retain legal accountability.

Despite acknowledging the efficiency of AI, trust in AI recommendations remained relatively low. A prevailing concern was that widespread AI adoption could weaken the patient–professional relationship, with the vast

majority prioritizing human expertise over automated recommendations.

According to the scale findings across three factors, participants demonstrated a strong perception of the benefits of AI applications ($M = 4.05$). In contrast, the low mean score obtained for the reverse-coded “Risks of Artificial Intelligence” factor ($M = 2.52$) indicates that participants hold a pronounced perception of risks associated with AI. The mean score for the “Use of Artificial Intelligence” factor was 3.57, suggesting that participants show a moderate-to-high tendency to use AI both for knowledge acquisition and content generation, as well as for social, creative, and entertainment purposes.

Independent samples *t*-tests showed that male students reported significantly higher scores for the perceived benefits of AI compared to female students (4.25

vs. 4.00; $p=0.001$) and, considering reverse coding, also demonstrated higher risk perceptions (2.77 vs. 2.45; $p=0.000$). Students who reported using AI scored significantly higher than non-users in terms of perceived benefits (4.12 vs. 3.79; $p=0.000$) and AI use (3.65 vs. 3.27; $p=0.000$), and they also exhibited higher risk perceptions (2.55 vs. 2.38; $p=0.028$; reverse coded).

One-way ANOVA results indicated no significant differences across age groups or year levels for any of the factors (all $p > 0.05$). However, significant differences were observed across departments for all three factors: benefits ($p=0.009$), risks ($p=0.002$), and use ($p=0.034$). Tukey post hoc comparisons revealed that Nutrition and Dietetics students reported lower benefit perceptions than students in Emergency Aid and Disaster Management and Nursing; in the risks subdimension, Social Work students had lower mean scores than Nursing students, which, due to reverse coding, indicates higher risk perceptions among Social Work students; and in the use subdimension, Healthcare Management students reported higher scores than Nutrition and Dietetics students. This pattern suggests that evaluations of AI benefits, risks, and use vary according to departmental professional orientation and curriculum content, whereas age and year level do not appear to be determining factors. These results are summarized in Table 2.

To examine students' attitudes toward AI in healthcare, a series of logistic regression models were estimated, each addressing a distinct attitudinal dimension. Model fit, explanatory power, and statistically significant predictors are reported below, with an emphasis on overarching patterns. Odds ratios and key predictors from the regression models are presented in Table 3.

Privacy and regulatory adequacy

Models addressing privacy risks and regulatory sufficiency revealed that risk perception was the dominant explanatory factor. The model assessing whether AI-based processing of patient data poses a serious privacy risk demonstrated good fit (Omnibus $p<0.001$; H-L $p=0.537$; $R^2 = 0.194$). Students who perceived lower

AI-related risks were substantially more likely to reject the view that AI processing constitutes a serious threat to privacy.

Similarly, the model evaluating perceptions of regulatory adequacy (Omnibus $p<0.001$; H-L $p=0.255$; $R^2 = 0.122$) showed that lower perceived risks and active AI use increased endorsement of current regulations as sufficient. Program affiliation and academic year also contributed modestly: first-year students and those enrolled in Emergency Aid and Disaster Management were more inclined to view existing regulations as adequate. Overall, these findings indicate that confidence in regulatory frameworks is closely tied to perceived risk reduction and practical exposure to AI, rather than to demographic factors alone.

Patient safety and clinical value

Models focusing on patient safety and clinical effectiveness consistently demonstrated that perceived benefits, reduced risk perception, and AI use jointly strengthen positive evaluations of AI's clinical contribution. The model examining expectations regarding AI-assisted diagnosis and treatment showed good fit (Omnibus $p<0.001$; H-L $p=0.099$; $R^2 = 0.165$), with students reporting higher perceived benefits, lower risks, and AI use being significantly more likely to endorse AI's contribution to patient safety.

Comparable patterns emerged in models addressing preventive healthcare efficiency ($R^2 = 0.202$) and chronic disease management ($R^2 = 0.158$). Across these outcomes, perceived benefits exerted a strong protective effect, while AI use reinforced favorable judgments. Academic seniority and program affiliation contributed to some variability; however, these effects were secondary to the central role of benefit–risk evaluations. Collectively, these findings suggest that instrumental and outcome-oriented judgments about AI are relatively well explained by attitudinal constructs, yielding moderate explanatory power.

Table 2 Difference analysis of AI attitude scale factors by demographic variables

Factor	Gender (t-test)	AI Usage (t-test)	Age (ANOVA)	Department (ANOVA)	Department – Tukey Multiple Comparison Summary	Year of Study (ANOVA)
AI Risks	$p=0.000$; Male>Female (2.77 > 2.45)	$p=0.028$; Users>Non-users (2.55 > 2.38)	$p=0.226$ (ns)	$p=0.002$	Social Work < Nursing (lower mean in Social Work → higher risk perception)	$p=0.730$ (ns)
AI Benefits	$p=0.001$; Male>Female (4.25 > 4.00)	$p=0.000$; Users>Non-users (4.12 > 3.79)	$p=0.698$ (ns)	$p=0.009$	Nutrition < EADM; Nutrition < Nursing	$p=0.478$ (ns)
AI Use	$p=0.470$ (ns)	$p=0.000$; Users>Non-users (3.65 > 3.27)	$p=0.774$ (ns)	$p=0.034$	Healthcare Management > Nutrition	$p=0.855$ (ns)

Table 3 Logistic regression models for predictors of patient safety and ethical judgments regarding generative AI

Model	Significant Predictors	OR [95%CI]	<i>p</i>	Omnibus <i>p</i>	H-L <i>p</i>	Nagelkerke R ²
M1	AI Risks* (Continuous)	2.55 [2.03 – 3.21]	< 0.001	< 0.001	0.537	0.194
M2	Dept: EADM (Ref: Healthcare Mgt.)	0.42 [0.20 – 0.88]	0.021	< 0.001	0.255	0.122
	Class: 1st Year (Ref: 4th) AI	0.42 [0.22 – 0.84]	0.014			
	Risks* (Continuous)	0.59 [0.48 – 0.74]	< 0.001			
	AI Use (Continuous)	0.59 [0.44 – 0.79]	0.001			
M3	Class: 1st Year (Ref: 4th)	0.51 [0.26 – 0.98]	0.045	< 0.001	0.099	0.165
	AI Benefits (Continuous)	0.71 [0.54 – 0.93]	0.013			
	AI Risks* (Continuous)	0.66 [0.52 – 0.83]	< 0.001			
	AI Use (Continuous)	0.61 [0.46 – 0.81]	0.001			
M5	Dept: Nursing (Ref: Health Mgt.)	2.05 [1.17 – 3.57]	0.012	0.112	0.214	0.040
	AI Risks* (Continuous)	1.26 [1.03 – 1.55]	0.025			
M6	Dept: EADM (Ref: Healthcare Mgt.)	0.41 [0.19 – 0.90]	0.026	0.184	0.865	0.036
M7	Gender: Male (Ref: Female)	1.71 [1.12 – 2.61]	0.013	< 0.001	0.811	0.143
	AI Risks* (Continuous)	0.65 [0.53 – 0.80]	< 0.001			
	AI Use (Continuous)	0.59 [0.45 – 0.78]	< 0.001			
M8	AI Risks* (Continuous)	1.57 [1.25 – 1.96]	< 0.001	< 0.001	0.203	0.094
	AI Use (Continuous)	1.61 [1.18 – 2.19]	0.002			
M9	AI Benefits (Continuous)	0.49 [0.36 – 0.66]	< 0.001	< 0.001	0.592	0.202
	AI Risks* (Continuous)	0.73 [0.57 – 0.94]	0.014			
	AI Use (Continuous)	0.64 [0.47 – 0.87]	0.004			
M10	Dept: EADM (Ref: Healthcare Mgt.)	0.39 [0.18 – 0.81]	0.011	< 0.001	0.218	0.260
	Dept: Nutrition (Ref: Healthcare Mgt.)	0.45 [0.25 – 0.80]	0.007			
	AI Benefits (Continuous)	1.88 [1.42 – 2.49]	< 0.001			
	AI Risks* (Continuous)	2.52 [1.98 – 3.20]	< 0.001			
	AI Use (Continuous)	1.47 [1.11 – 1.95]	0.007			
M11	Dept: Nursing (Ref: Healthcare Mgt.)	0.41 [0.19 – 0.90]	0.026	< 0.001	0.565	0.158
	Class: 1st Year (Ref: 4th)	0.36 [0.17 – 0.77]	0.008			
	Class: 3rd Year (Ref: 4th)	0.18 [0.09 – 0.39]	< 0.001			
	Uses AI (Ref: No)	0.59 [0.35 – 0.98]	0.042			
	AI Benefits (Continuous)	0.55 [0.40 – 0.77]	< 0.001			
M12	Gender: Male (Ref: Female)	0.61 [0.38 – 0.96]	0.034	< 0.001	0.247	0.252
	AI Benefits (Continuous)	1.46 [1.07 – 2.01]	0.018			
	AI Risks* (Continuous)	2.78 [2.15 – 3.59]	< 0.001			
	Dept: Social Work (Ref: Healthcare Mgt.)	2.10 [1.08 – 4.06]	0.029			

*Risks is reverse-coded; higher scores indicate a lower level of perceived risk

Responsibility and accountability judgments

In contrast, models addressing responsibility attribution following AI-related errors exhibited weak explanatory power. Models concerning physician responsibility and developer liability failed to reach statistical significance at the model level or demonstrated only marginal fit (R^2 values below 0.05). Although certain coefficients appeared statistically significant, the weak overall model performance limits inferential interpretation. Therefore, the statistical significance of these predictors should be interpreted with caution, as the low R^2 values indicate that the models have very limited explanatory power.

These results indicate that responsibility judgments are less structurally determined by attitudinal predictors such as perceived risks, benefits, or AI use. Rather than reflecting coherent evaluative patterns, students' responses appear fragmented, suggesting normative

ambiguity regarding accountability in AI-mediated healthcare contexts.

Trust, reliance, and professional interaction

Models examining trust in AI recommendations and reliance on AI relative to human expertise demonstrated statistically significant but comparatively modest explanatory power ($R^2 \approx 0.09$ – 0.14). Lower perceived risks and higher AI use were associated with greater trust in AI and reduced concern about overreliance on automated systems, although the explanatory power of these factors remained limited. Gender differences emerged in the trust model, with male students being less inclined to endorse trust in AI recommendations.

A related model addressing professional–patient communication showed moderate explanatory power ($R^2 = 0.252$). While male students were more likely to

anticipate communication erosion, higher perceived benefits and lower risk perceptions increased rejection of this concern. These findings suggest that evaluations of relational and interactional consequences of AI are more complex than instrumental assessments, but still partially shaped by core attitudinal dimensions.

Public health concerns

The model assessing concerns that AI systems may harm public health exhibited the highest relative explanatory power among all models, reaching a moderate level ($R^2 = 0.260$). Students who perceived higher benefits, lower risks, and who reported AI use were more likely to reject the notion that AI poses a public health threat. By contrast, students from Emergency Aid and Disaster Management and Nutrition and Dietetics programs expressed comparatively greater concern.

This model underscores that macro-level evaluations of AI's societal impact are conditioned by benefit–risk trade-offs, yielding clearer attitudinal structure than responsibility-focused judgments.

Summary of patterns

Across models, explanatory power ranged from approximately 2% to 26%, indicating weak to moderate associations according to standard interpretations of Nagelkerke R^2 . The most consistent and influential determinant was perceived risk (reverse-coded): as perceived risk decreased, students were systematically more likely to reject negative statements and endorse positive evaluations of AI. Perceived benefits and actual AI use reinforced this pattern, particularly in domains related to patient safety, efficiency, and public health.

By contrast, judgments concerning responsibility and accountability following AI-related errors demonstrated weak explanatory structure, suggesting unresolved normative uncertainty. Taken together, the findings indicate a clear asymmetry: while instrumental and outcome-oriented attitudes toward AI are coherently structured, responsibility-related evaluations remain diffuse and poorly anchored in attitudinal predictors.

Discussion

The most salient finding of this study is that students of health sciences evaluate AI primarily through the triad of benefit–risk–use. In particular, risk perception emerged as the strongest predictor of whether students hold favorable or unfavorable attitudes. This pattern indicates that students' decisions are shaped not by irrational anxieties but by a rational balance between perceived benefits and risks. The findings are also consistent with the predictions of leading theoretical models of technology acceptance (TAM; UTAUT), as perceived usefulness and ease of use function as facilitators of behavioral intention,

whereas risk perception operates as a constraining factor [14, 15]. Unlike previous studies that have approached students' attitudes toward AI only at a superficial level (e.g., literacy or general awareness), this study contributes to the literature by linking perceptual dimensions to ethical awareness, clinical decision-making, and public health.

Ethical awareness and data privacy

More than half of the students reported that the processing of patient data by AI-based applications posed a serious risk to privacy, while the vast majority indicated that current legal regulations are insufficient to safeguard data security. This finding is consistent with the ethical concerns and data privacy issues frequently highlighted in the literature. Previous studies demonstrate that the use of AI entails risks of privacy breaches, unauthorized access, and misuse [1, 3, 7]. In particular, the potential misuse of data by commercial entities and the uncertainties surrounding data storage processes further reinforce these concerns [4, 8].

The strong perception of inadequacy in legal regulations also reflects a gap frequently noted in the literature. As AI remains a relatively new phenomenon in healthcare, the absence of established standards regarding informed consent, anonymization, and secure labeling leads to practical challenges [1, 12, 13]. This perception of regulatory insufficiency should be interpreted within the specific legal context of Türkiye. Although the country enforces a comprehensive legal framework for personal data protection, it has not yet enacted a standalone statutory framework specifically targeting artificial intelligence. Consequently, the students' skepticism likely reflects this specific transitional phase in the national legal landscape, where general data protection laws exist but specific AI governance is still evolving. Nevertheless, some studies indicate that when risks are perceived as low, patients and the public are more willing to share their anonymized data [1, 17]. Beyond these descriptive trends, multivariable analysis identifies the underlying predictors. Consistent with these findings, our study likewise shows that students with lower risk perceptions are more likely to dismiss privacy concerns.

In summary, the findings reveal students' strong concerns about data privacy and their perception of the inadequacy of the current legal framework. This underscores the need for ethical awareness highlighted in the literature and indicates that educational programs for health sciences students should encompass not only technical competencies but also ethical dimensions [18, 19].

Clinical decision-making and professional responsibility

Most students stated that AI-assisted diagnostic and treatment recommendation systems could enhance

patient safety. However, there was considerable uncertainty regarding who should bear professional responsibility in the event of an error. Approximately half of the participants argued that physicians should remain legally accountable, while a substantial proportion maintained that responsibility should lie with developer companies. This dual perspective illustrates that the ethical and legal boundaries of AI in clinical decision-making processes remain contested.

The literature supports these findings. While studies emphasize that AI can enhance diagnostic accuracy and reduce medical errors [1, 2, 6] concerns regarding the reliability and transparency of AI algorithms, including potential biases and the “black-box” nature of these technologies, persist [20]. Consequently, the allocation of responsibility in the event of errors remains one of the most contested issues. It is stated that determining accountability, whether it lies with the nurse, the physician, or the software, is a critical ethical and legal challenge when AI systems impact patient outcomes [11]. Some research suggests that responsibility should be shared among physicians, patients, and developer companies [4], whereas others argue that primary liability should rest with the institutions that design the systems [8, 21]. Conversely, there are also perspectives asserting that physicians, as ultimate decision-makers, should continue to bear responsibility [22].

Moving beyond these descriptive stances, multivariable analysis identifies limited but statistically significant predictors of these accountability judgments. Notably, it was observed that nursing students and those who perceived the risks as lower were less likely to endorse the view that developers should be held responsible for misdiagnosis. Although the explanatory power of the models is weak, this finding aligns with previous studies indicating that nursing students demonstrate relatively low to moderate levels of awareness regarding the ethics of AI [18, 19, 23].

In summary, while students believe that AI can strengthen clinical decision-making, they do not share a common stance on how responsibility should be allocated. This ambiguity in students’ responses reflects the theoretical challenge known as the ‘Responsibility Gap’ in AI ethics. The ‘black-box’ nature of AI algorithms complicates the traditional ‘fault-based’ liability models, as it becomes difficult to pinpoint whether an error stems from the clinician’s supervision or the developer’s code. Our findings suggest that students’ fragmented views on liability are not merely a lack of knowledge but a reflection of this systemic normative gap. This normative ambiguity is quantitatively substantiated by the limited explanatory power ($R^2 < 0.1$) of our models. The fact that established predictors, such as risk perception and AI usage, account for such a negligible portion of the variance is thought to indicate that students’

liability judgments are not yet anchored in a stable attitudinal framework. Rather than signaling a methodological gap, the low explanatory power of the models is considered to reflect the absence of established accountability norms, suggesting fragmented and unstructured responses regarding professional liability. Without a clear legal framework to bridge this gap, the integration of AI into the workforce may be met with hesitation by future health professionals, driven by their unresolved concerns regarding accountability risks.

Trust in AI, human Expertise, and clinical practice

Less than half of the participants reported that they could trust AI recommendations in professional practice, whereas a large majority expressed that relying on AI recommendations instead of human expertise would be problematic. This finding indicates that while students perceive AI as a supportive tool, they underscore the indispensability of human expertise. Similarly, the literature emphasizes that AI should serve as an aid to clinical decision-making rather than a replacement for physicians [24, 25].

Multivariable analysis further clarifies the specific factors shaping these levels of trust. Our findings revealed differences based on gender and risk perception. Male students were more likely to reject expressions of trust, whereas those who perceived lower levels of risk and reported more frequent use of AI were more inclined to trust it. The literature similarly notes that male students, compared to their female students, tend to exhibit more positive attitudes toward AI and a higher perception of its benefits. In contrast, female students are reported to display more negative attitudes, express greater concerns and reservations, and use AI tools less frequently [19, 26, 27].

It is also noteworthy that, despite the model’s modest explanatory power, students with lower risk perceptions and more frequent AI use were more inclined to perceive reliance on AI over human expertise as unproblematic. Similarly, the literature highlights that prior experience with AI use increases trust levels and strengthens perceptions of its benefits [28]. In conclusion, students adopt a cautious stance toward trusting AI, with levels of trust varying according to gender, risk perception, and prior experience with its use.

Perceptions of preventive healthcare and public health

In our study, the majority of students indicated that AI-based applications could enhance the efficiency of preventive healthcare services, while nearly half expressed concern that such applications might harm public health. This finding suggests that although students acknowledge the potential contributions of AI, they remain cautious about possible risks. Similarly, the literature highlights that AI can improve efficiency in early diagnosis, risk

analysis, data management, and resource utilization [1, 8, 29], while also pointing out that its indirect effects on public health may raise broader societal concerns related to ethics and equity [2, 5, 17, 30].

The multivariable models further explain these public health perceptions by highlighting the impact of departmental background and attitudinal factors. Additional differences across departments are noteworthy: students from EADM and Nutrition were more likely to share this concern, whereas those with higher benefit perception and lower risk perception adopted a more positive stance. This pattern indicates that professional orientation plays an important role in shaping attitudes toward public health [31].

In conclusion, although students strongly believe that AI can enhance efficiency in preventive healthcare services, concerns about its potential to harm public health remain significant. The findings support the theme of “the coexistence of opportunities and threats” emphasized in the literature and underscore the need to strengthen ethical, social, and legal frameworks to ensure the societal adoption of AI.

Chronic disease management and patient safety

A vast majority of students indicated that AI applications could be effective in chronic disease management, and most participants stated that they could enhance patient safety. These findings demonstrate that students perceive AI not only as a tool for diagnosis and treatment but also as an important resource in long-term care and patient safety.

The literature supports these findings. Studies report that AI is particularly effective in areas such as remote monitoring, medication adherence, and tracking lifestyle changes, while also supporting patient care by providing real-time data to healthcare professionals and enhancing safety by reducing clinical errors [1, 2, 8, 32].

Our multivariable analysis further revealed that nursing students were more likely to endorse the view that AI could be effective in chronic disease management. The literature similarly indicates that while nursing students generally hold positive attitudes toward AI, their level of ethical awareness may be relatively low [18, 19]. In addition, first-year students, those with a higher perception of benefit, and those who reported using AI were more likely to strongly support the view that AI enhances patient safety. These findings are consistent with previous research demonstrating that perceived benefit and usage experience increase trust in AI [6, 12].

Communication, relationships, and professional roles

Significant proportion of students expressed the view that AI would weaken communication between healthcare professionals and patients. Our multivariable

models further reveal that male students were more likely to agree with this statement, whereas students with higher benefit perception, lower risk perception, and those studying Social Work were more likely to reject it. This finding indicates that different groups perceive the impact of AI on communication in distinct ways.

Similarly, the literature reports that both patients and healthcare professionals express concerns that AI may negatively affect patient–physician communication and trust [3, 33, 34]. The mismatch between patients’ expectations for empathetic care and the mechanical approach of AI increases the risk of trust erosion [17, 34]. In addition, the widespread use of AI has been associated with the danger of deskilling, whereby clinicians’ communication and assessment skills may deteriorate [1].

Nevertheless, the literature emphasizes that while AI can support the tasks of data-intensive healthcare professionals, it cannot replace human–patient communication in areas requiring empathy, emotional support, and clinical judgment [1, 35].

In conclusion, students hold a strong perception that AI may weaken patient–healthcare professional communication. However, some groups also view AI as a supportive tool for communication. These findings align with perspectives suggesting that AI cannot substitute for empathy and human interaction in healthcare, but, when used appropriately, it can serve a complementary role in enhancing communication.

Differences: gender, departments, and usage experience

Male students reported higher benefit and risk perceptions but were less likely to trust AI in professional practice compared to their female counterparts. This aligns with prior research indicating that men often display greater AI awareness yet adopt a more critical stance, whereas women tend to exhibit more caution [26, 31], potentially due to disparities in educational content or technology access [27].

Departmental variations were also significant; Nutrition and Dietetics students perceived lower benefits, while Social Work students reported higher risk perceptions compared to Nursing and Emergency Aid and Disaster Management students. Consistent with studies showing that medical and nursing students often view AI more positively [2, 35–37] than those in allied health disciplines like nutrition or psychology [38], these findings confirm that professional orientation and curricular content significantly shape AI attitudes.

Finally, prior AI usage emerged as a robust predictor; current users assigned higher scores to benefits and lower scores to risks. This corroborates literature suggesting that direct experience mitigates risk perception and fosters a view of AI as an opportunity rather than a threat [39]. Collectively, while gender, department, and

experience are key determinants, the varying explanatory power across models suggests that these results should be interpreted with attention to the specific context of each discipline.

Overall evaluation and future directions

The empirical evidence gathered through this research points toward several strategic considerations for the future of health sciences education. In light of the widespread skepticism regarding current legal frameworks and the specific privacy concerns identified by students, a mandatory module on Digital Health Law and Data Governance is essential to bridge the gap between technological adoption and regulatory trust. Furthermore, the Responsibility Gap manifested through the normative ambiguity in liability judgments and the weak predictive power of attitudinal variables in the regression models, necessitates the integration of case-based simulations focusing on Algorithmic Accountability and the legal boundaries of AI-assisted errors. To address the concerns regarding the potential erosion of patient-provider interactions, training should incorporate AI-Augmented Communication strategies that emphasize maintaining empathy and human-centered care alongside digital tools. Finally, since risk perception consistently stood out as the primary predictor of AI attitudes across all dimensions, curricula must move beyond basic technical literacy toward Risk-Benefit Critical Appraisal, enabling future professionals to navigate the opportunity–risk dichotomy with analytical competence.

Methodologically, this research transcends common descriptive approaches by employing 12 independent logistic regression models to provide an explanatory mapping of how attitudinal factors predict specific ethical and clinical judgments. Furthermore, it theoretically extends the scope of the Technology Acceptance Model (TAM) and UTAUT from predicting mere technological adoption to explaining complex professional outcomes like accountability and ethical awareness. This study makes a threefold contribution to the literature. First, by examining health sciences students' perceptions of AI not only in terms of general attitudes and awareness but also in relation to ethical awareness, clinical responsibility, and public health, it addresses an important gap in the literature. Second, by empirically testing theoretical frameworks such as the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT) in the context of health sciences students, it demonstrates that perceived benefit, risk, and usage experience shape not only behavioral intentions but also ethical and professional outcomes. Third, by revealing disciplinary differences and the effects of usage

experience, it provides concrete evidence that future educational programs should incorporate not only technical but also ethical competencies.

Our findings reveal that students exhibit a dual approach toward AI: on the one hand, they acknowledge its potential to enhance efficiency in patient safety, chronic disease management, and preventive healthcare; on the other, they express concerns about risks such as data privacy, ethical responsibility, and weakened communication. This duality supports the theme of “the simultaneous presence of opportunities and threats” frequently emphasized in the literature [1, 4, 5, 40]. Risk perception emerged as the most influential factor shaping students' attitudes, a finding consistent with prior research reporting that risk perception affects trust, perceived benefit, and adoption intentions [17, 39, 41]. The results underscore that curricula in health sciences education should not be limited to technical skills but must also incorporate ethical awareness, data privacy, professional responsibility, and communication competencies.

Our study demonstrates that while AI holds transformative potential in healthcare, this transformation must be pursued with the preservation of ethical and human values. The findings reveal that future healthcare professionals perceive AI both as an opportunity and as a source of risk, highlighting a dual approach that represents a critical consideration for shaping health policies.

Conclusion

This study highlights that risk perception is the strongest factor shaping health sciences students' attitudes toward AI, outweighing demographic characteristics. Rather than showing blind acceptance, students recognized the potential benefits of AI for efficiency and patient safety while maintaining a cautious stance regarding data privacy and trust. This rational evaluation of the risk–benefit balance suggests that students view AI as a complex tool requiring careful integration, a finding that extends frameworks such as TAM and UTAUT in the context of health education.

Based on these findings, three key practical implications emerge. First, health sciences curricula must go beyond technical literacy to include comprehensive modules on ethics, professional responsibility, and communication. Second, policymakers need to develop clear regulations concerning accountability and data governance to alleviate trust concerns. Third, to foster trust among emerging healthcare professionals, AI should be explicitly introduced in training and transition-to-practice phases as a supportive tool rather than a replacement, thereby addressing students' concerns about the preservation of empathy.

Limitations

The findings of this study should be considered in light of certain limitations. First, the research was conducted within a single national context and with students from selected health sciences disciplines. Moreover, as the study was conducted at a single university (single-center), the generalizability of the findings to the broader population of health sciences students may be further constrained. Second, the cross-sectional design does not allow for causal inferences regarding the relationships among risk perception, benefit perception, and attitudes. Third, the data were collected through self-report scales, which may introduce response bias and may not fully reflect students' actual behaviors or clinical decision-making practices. In particular, the voluntary nature of participation may have introduced selection bias. Furthermore, the face-to-face data collection process might have triggered social desirability bias, leading participants to provide responses they perceived as more acceptable or favorable. Fourth, the use of binary (yes/no) question formats may have limited the depth of analysis regarding complex ethical issues, potentially oversimplifying the participants' nuanced perspectives on AI ethics. Additionally, this binary structure may overlook nuances in participants' views, potentially leading to misclassification bias and reduced sensitivity in capturing complex ethical distinctions. Therefore, future research is encouraged to employ Likert-based scales or mixed-method designs to capture these nuances more effectively and provide a deeper understanding of students' perspectives.

Nevertheless, this study provides an important starting point for understanding future healthcare professionals' perceptions and attitudes toward AI. Future research should adopt multicenter, longitudinal designs to examine how attitudes toward AI evolve across different stages of education and to validate these patterns within clinical practice.

Abbreviations

AI	Artificial Intelligence
EADM	Emergency Aid and Disaster Management
Nutrition	Nutrition and Dietetics
Dept	Department
Ref	Reference Category
Healthcare Mgt	Healthcare Management

Authors' contributions

C.U. conceptualized the study, designed the methodology, conducted the formal analysis, wrote the original draft, and supervised the overall process. S.Ş. contributed to data curation and co-authored the manuscript, participating in the review and editing process. All authors reviewed and approved the final version of the manuscript.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Data availability

The datasets analysed during the current study are not publicly available due to restrictions imposed by the institutional ethics committee, which prohibit public data sharing, but are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

In this study, participation was entirely voluntary, and data were collected only from individuals who agreed to participate. All participants were fully informed about the purpose, scope, and confidentiality principles of the research, and written informed consent was obtained from all participants prior to data collection. The study was conducted in accordance with the Declaration of Helsinki. All data collected during the research process were analyzed anonymously, with strict adherence to the confidentiality of personal information.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Received: 18 December 2025 / Accepted: 27 January 2026

Published online: 31 January 2026

References

1. Vo V, Chen G, Aquino YSJ, Carter SM, Do QN, Woode ME. Multi-stakeholder preferences for the use of artificial intelligence in healthcare: A systematic review and thematic analysis. *Soc Sci Med*. 2023. <https://doi.org/10.1016/j.socscimed.2023.116357>.
2. Srivani RM, Kumar SB, Naveen A, Venkat JN. Awareness of medical students about the role of artificial intelligence in health care: A survey-based cross-sectional study. *Natl J Physiol Pharm Pharmacol*. 2024;14:490–4. <https://doi.org/10.5455/njppp.2024.14.01021202426012024>.
3. Issa WB, Shorbagi A, Al-Sharman A, Rababa M, Al-Majeed K, Radwan H, et al. Shaping the future: perspectives on the integration of artificial intelligence in health profession education: a multi-country survey. *BMC Med Educ*. 2024;24:1166. <https://doi.org/10.1186/s12909-024-06076-9>.
4. Falcon RMG, Alcazar RMU, Babaran HG, Caragay BDB, Corpuz CAA, Kho MVS, et al. Exploring Filipino medical students' attitudes and perceptions of artificial intelligence in medical education: A Mixed-Methods study. *MedEdPublish*. 2025;14:282. <https://doi.org/10.12688/mep.20590.1>.
5. Mwase NS, Patrick SM, Wolvaardt J, van Wyk M, Junger W, Wichmann J. Public health practice and artificial intelligence: views of future professionals. *J Public Health*. 2025;33:1481–9. <https://doi.org/10.1007/s10389-023-02127-5>.
6. Sanad AH, Alsaegh AS, Abdulla HM, Mohamed AJ, Alqassab A, Sharaf SMA, et al. Perceptions of artificial intelligence in medicine among newly graduated interns: A Cross-Sectional study. *Cureus*. 2024. <https://doi.org/10.7759/cureus.71216>.
7. Sherry O, Kim J, Bonilla J, Montalvo F, Veas M. Student and faculty perspectives on AI in health education: an exploratory systematic review. *Rev Esp Edu Med*. 2025. <https://doi.org/10.6018/edumed.633811>.
8. Ahmad MN, Abdallah SA, Abbasi SA, Abdallah AM. Student perspectives on the integration of artificial intelligence into healthcare services. *Digit Health*. 2023. <https://doi.org/10.1177/20552076231174095>.
9. Batran A, Ayed A, Aqdam I, Al-Amer R, Othman EH, Ejheisheh MA, et al. Insights into perceived worries regarding the adoption of artificial intelligence among intensive care unit nurses in the West bank. *SAGE Open Nurs*. 2025;11:23779608251376177. <https://doi.org/10.1177/23779608251376177>.
10. Salameh B, Qaddumi J, Hammad B, Eqtit F, Ibraheem Ayed AJ, Fashafsheh I, et al. Nursing students' attitudes toward artificial intelligence: Palestinian perspectives. *SAGE Open Nurs*. 2025;11:23779608251343297. <https://doi.org/10.1177/23779608251343297>.
11. Ayed A, Batran A, Aqdam I, Malak MZ, Ejheisheh MA, Farajallah M, et al. Perceived worries in the adoption of artificial intelligence among nurses in neonatal intensive care units. *BMC Nurs*. 2025;24:777. <https://doi.org/10.1186/s12912-025-03318-z>.

12. Subaveerapandiyan A, Mvula D, Ahmad N, Taj A, Ahmed MG. Assessing AI literacy and attitudes among medical students: implications for integration into healthcare practice. *J Health Organ Manag.* 2024. <https://doi.org/10.1108/JHOM-04-2024-0154>.
13. Tahri Sqalli M, Aslonov B, Gafurov M, Nurmatov S. Humanizing AI in medical training: ethical framework for responsible design. *Front Artif Intell.* 2023;6:1189914. <https://doi.org/10.3389/frai.2023.1189914>.
14. Davis FD, Perceived, Usefulness. Perceived ease of Use, and user acceptance of information technology. *MIS Q.* 1989;319–40. <https://www.jstor.org/stable/249008>.
15. Venkatesh V, Morris MG, Davis GB, Davis FD. User acceptance of information technology: toward a unified view. *MIS Q.* 2003;425–78. <https://www.jstor.org/stable/30036540>.
16. AKTAY S, GÖK S, Yıldırım A. Artificial intelligence attitude scale. *Int Technol Educ J.* 2024;8:14–24.
17. Fadil H, Alahmadi Y. Evaluation of awareness, perceptions and opinions of artificial intelligence (AI) among healthcare students – A cross-sectional study in Saudi Arabia. *Trop J Pharm Res.* 2025;23:2097–105. <https://doi.org/10.4314/tjpr.v23i12.15>.
18. Yang Y. Influences of digital literacy and moral sensitivity on artificial intelligence ethics awareness among nursing students. *Healthcare.* 2024;12:2171. <https://doi.org/10.3390/healthcare12212172>.
19. Migdadi MK, Oweidat IA, Alosta MR, Al-Mugheed K, Saeed Alabdullah AA, Farghaly Abdelallem SM. The association of artificial intelligence ethical awareness, attitudes, anxiety, and intention-to-use artificial intelligence technology among nursing students. *Digit Health.* 2024;10:20552076241301958. <https://doi.org/10.1177/20552076241301958>.
20. Albahri AS, Duhaime AM, Fadhel M, Alnoor A, Baqer NS, Alzubaidi L, et al. A systematic review of trustworthy and explainable artificial intelligence in healthcare: assessment of quality, bias risk, and data fusion. *Inform Fusion.* 2023;96:156–91. <https://doi.org/10.1016/j.inffus.2023.03.008>.
21. Allam RM, Abdelfatah D, Khalil MIM, Elsaieed MM, El Desouky ED. Medical students and house officers' perception, attitude and potential barriers towards artificial intelligence in Egypt, cross sectional survey. *BMC Med Educ.* 2024;24:1244. <https://doi.org/10.1186/s12909-024-06201-8>.
22. Tung AYZ, Dong LW. Malaysian medical students' attitudes and readiness toward AI (artificial intelligence): a cross-sectional study. *J Med Educ Curric Dev.* 2023;10:1–8. <https://doi.org/10.1177/23821205231201164>.
23. Jha N, Shankar PR, Al-Betar MA, Mukhia R, Hada K, Palaian S. Undergraduate medical students' and interns' knowledge and perception of artificial intelligence in medicine. *Adv Med Educ Pract.* 2022;13:927–37. <https://doi.org/10.2147/AMEP.S368519>.
24. Buabbas AJ, Miskin B, Alnaqi AA, Ayed AK, Shehab AA, Syed-Abdul S, Uddin M. Investigating students' perceptions towards artificial intelligence in medical education. *Healthc (Basel).* 2023. <https://doi.org/10.3390/healthcare11091298>.
25. Yaynisheset YA, Nasir FM, Hailu SS, Solomon DZ, Gidena EK, Bedewi AM, et al. Medical students' attitude towards artificial intelligence in medicine. A National Multicenter Survey; 2024. <https://doi.org/10.21203/rs.35-3655543/v1>.
26. Maaß L, Grab-Kroll C, Koerner J, Öchsner W, Schön M, Messerer D, et al. Artificial intelligence and ChatGPT in medical education: A Cross-Sectional questionnaire on students' competence. *J CME.* 2025;14:2437293. <https://doi.org/10.1080/28338073.2024.2437293>.
27. Bisdas S, Topriceanu C-C, Zakrzewska Z, Irimia A-V, Shakallis L, Subhash J, et al. Artificial intelligence in medicine: A multinational Multi-Center survey on the medical and dental students' perception. *Front Public Health.* 2021;9:795284. <https://doi.org/10.3389/fpubh.2021.795284>.
28. Rodríguez-Arrastia M, Martínez-Ortigosa A, Ruiz-Gonzalez C, Ropero-Padilla C, Roman P, Sanchez-Labraca N. Experiences and perceptions of final-year nursing students of using a chatbot in a simulated emergency situation: A qualitative study. *J Nurs Adm Manag.* 2022;30:3874–84. <https://doi.org/10.1111/jonm.13630>.
29. Truong NM, Vo TQ, Tran HTB, Nguyen HT, van Pham NH. Healthcare students' knowledge, attitudes, and perspectives toward artificial intelligence in the Southern Vietnam. *Heliyon.* 2023;9:e22653. <https://doi.org/10.1016/j.heliyon.2023.e22653>.
30. Beets B, Newman TP, Howell EL, Bao L, Yang S. Surveying public perceptions of artificial intelligence in health care in the united states: systematic review. *J Med Internet Res.* 2023;25:e40337. <https://doi.org/10.2196/40337>.
31. Derakhshanian S, Wood L, Arruzza E. Perceptions and attitudes of health science students relating to artificial intelligence (AI): A scoping review. *Health Sci Rep.* 2024;7:e2289. <https://doi.org/10.1002/hsr2.2289>.
32. Lu H, Alhaskawi A, Dong Y, Zou X, Zhou H, Ezzi SHA, et al. Patient autonomy in medical education: navigating ethical challenges in the age of artificial intelligence. *INQUIRY: J Health Care Organ Provis Financing.* 2024;61:469580241266364. <https://doi.org/10.1177/00469580241266364>.
33. Meyer AND, Giardina TD, Spitzmueller C, Shahid U, Scott TMT, Singh H. Patient perspectives on the usefulness of an artificial Intelligence-Assisted symptom checker: Cross-Sectional survey study. *J Med Internet Res.* 2020;22:e14679. <https://doi.org/10.2196/14679>.
34. Nadarzynski T, Miles O, Cowie A, Ridge D. Acceptability of artificial intelligence (AI)-led chatbot services in healthcare: A mixed-methods study. *Digit Health.* 2019;5:2055207619871808. <https://doi.org/10.1177/2055207619871808>.
35. Al Hadithy ZA, Al Lawati A, Al-Zadjali R, Al Sinawi H. Knowledge, Attitudes, and perceptions of artificial intelligence in healthcare among medical students at Sultan Qaboos university. *Cureus.* 2023;15:e44887. <https://doi.org/10.7759/cureus.44887>.
36. Amir H, Peiravi S, Rezazadeh Shojae S, Rouhparvarzamin M, Nateghi MN, Etemadi MH, et al. Medical, dental, and nursing students' attitudes and knowledge towards artificial intelligence: a systematic review and meta-analysis. *BMC Med Educ.* 2024;24:412. <https://doi.org/10.1186/s12909-024-05406-1>.
37. Busch, F., Hoffmann, L., Truhn, D. et al. Global cross-sectional student survey on AI in medical, dental, and veterinary education and practice at 192 faculties. *BMC Med Educ* 24, 1066 (2024). <https://doi.org/10.1186/s12909-024-06035-4>.
38. Salas-García MA. Actitudes/percepciones relacionadas al Uso de inteligencia artificial En La atención sanitaria Entre estudiantes universitarios. *Investigación En educación médica.* 2025;14:61–71. <https://doi.org/10.22201/fm.20075057e.2025.53.24624>.
39. Schwesig R, Brich I, Buder J, Huff M, Said N. Using artificial intelligence (AI)? Risk and opportunity perception of AI predict people's willingness to use AI. *J Risk Res.* 2023;26:1053–84. <https://doi.org/10.1080/13669877.2023.2249927>.
40. Ayed A, Ejheisheh MA, Al-Amer R, Aqdam I, Ali AM, Othman EH, et al. Insights into the relationship between anxiety and attitudes toward artificial intelligence among nursing students. *BMC Nurs.* 2025;24:812. <https://doi.org/10.1186/s12912-025-03490-2>.
41. Cherez-Ojeda I, Gallardo-Bastidas JC, Robles-Velasco K, Osorio MF, Velez Leon EM, Leon Velastegui M et al. Understanding Health Care Students' Perceptions, Beliefs, and Attitudes Toward AI-Powered Language Models: Cross-Sectional Study 2023. <https://doi.org/10.2196/preprints.51757>.

Publisher's note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.