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Survey on cancer patients' attitudes towards AI and data protection: A cross-sectional study from an Italian cancer center

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HIGHLIGHTS

- 70.1% of patients can define AI and 85.5% are aware of its medical applications.
- 76.9% are willing to share data for research to improve cancer care.
- Main concerns: reduced human contact (63.2%) and loss of physician judgment (52.1%).
- 82.9% support AI if doctors retain decision-making authority.
- Findings support AI adoption with safeguards for privacy, education, and transparency.

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ABSTRACT

Background
Artificial Intelligence (AI) is increasingly integrated into oncology, offering opportunities to improve diagnostics, treatment planning, and operational efficiency. However, patient perspectives on AI, especially regarding data protection and ethical implications, remain underexplored.
Objective
The objective of this study is to investigate cancer patients' attitudes toward the use of Artificial Intelligence (AI) in healthcare, focusing on their awareness of data protection, perceived risks and benefits, and the conditions under which AI is considered acceptable. Additionally, the study aims to examine how demographic and educational factors influence patients' views within the context of an Italian comprehensive cancer center.
Methods
A cross-sectional survey was conducted with 117 cancer patients who completed a 28-item online questionnaire. The survey evaluated levels of AI knowledge, perceptions of data privacy, concerns about AI in medical contexts, and willingness to share health data for research.
Results
Most participants demonstrated moderate awareness of AI (70.1%) and its medical applications (85.5%), with higher familiarity observed among younger and more educated individuals. While data protection understanding varied, 76.9% were willing to share personal health data for research aimed at improving cancer care. Concerns included reduced physician autonomy (52.1%) and diminished physician-patient interaction (63.3%). However,

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82.9% of respondents found AI acceptable when clinical decisions remained under physician control. AI was most favorably viewed for administrative support and care process optimization.

Conclusion

Cancer patients generally view AI in healthcare positively, especially when it maintains physician oversight and safeguards data privacy. To ensure equitable and informed adoption, targeted educational initiatives and transparent communication strategies should address generational, educational, and digital literacy differences.

1. Introduction

1.1. Artificial intelligence in medicine

Artificial Intelligence (AI), defined by Marvin Minsky as the science of enabling machines to mimic human intelligence [1], has progressed rapidly since its formal inception in 1956. Advances in machine learning, computing infrastructure, and the abundance of health data [2] have accelerated its integration into various medical fields, notably oncology [3].

Radiology represents one of the most established areas of AI application, supporting disease pattern recognition and feature extraction beyond human perception [4–7]. AI also facilitates the integration of heterogeneous data (radiomics, genomics, pathology, proteomics, and clinical records) enabling predictive models for precision medicine [8, 9]. Furthermore, AI contributes to workflow optimization and increased clinical efficiency [10].

Despite its promise in cancer care, AI's rapid evolution raises significant technical, ethical, and regulatory concerns. Its performance relies on the quality and diversity of training data, while large-scale data use poses privacy risks [9,11]. Biased datasets may produce inequitable outcomes [12], and the "black box" nature of many AI systems limits transparency and accountability even for clinicians [13,14]. Additionally, although AI can reduce administrative workloads, it may unintentionally reduce physician–patient interaction, potentially affecting the therapeutic relationship.

The increasing integration of AI in healthcare has sparked extensive debate and raised unresolved questions regarding its practical use [15]. To bridge these gaps, recent research has examined stakeholders' attitudes, knowledge, and acceptance of AI [16–20]. While several studies have focused on healthcare professionals, yielding mixed results [17,20–23], less is known about patients' perspectives [24,25]. Notably, Lennartz et al. found that patients generally trust physicians more than AI, except when AI leverages the most up-to-date scientific evidence [26]. Similarly, Richardson et al. highlighted patient concerns about safety and data security [27]. Although patient views have been explored in specific specialties or diagnostic settings [28–35], a broader understanding remains limited.

Most studies on patient attitudes toward AI in healthcare were conducted before AI tools like ChatGPT became widely accessible and raised public awareness [36]. Only a few recent investigations have focused specifically on cancer patients' views [28,37,38], leaving a significant knowledge gap, which is particularly relevant given the rapid evolution of AI and the projected 21% rise in cancer incidence by 2040, primarily among individuals aged 65 and older [39]. As primary stakeholders, patients must be involved early in the innovation process to ensure AI systems align with their needs and to support successful implementation in oncology.

1.2. Aim of the survey

This study assessed cancer patients' attitudes towards AI in medicine. Using a survey conducted in a leading Italian research hospital, we explored how cancer patients perceive the impact of AI on cancer care and the associated data protection issues, also trying to understand what influences their views, to guide future implementation strategies. Patient insights can guide healthcare providers and policymakers, especially in light of recent EU legislation promoting safe and responsible AI implementation [40].

2. Methods

2.1. Setting

This prospective study explored the perspectives of oncology patients on data protection and artificial intelligence at the IRCCS Istituto Romagnolo per lo Studio dei Tumori "Dino Amadori" (IRST), a nationally and internationally recognized oncology center in the Emilia-Romagna Region, Italy. In partnership with the Local Health Authority (AUSL Romagna), IRST coordinates oncology services for a population of approximately 1.12 million people, recording around 180,000 patient visits annually (about 27,000 unique patients).

2.2. Survey development

We conducted an observational, quantitative, cross-sectional survey, developed through a multidisciplinary literature scoping review involving medical professionals, data experts (in AI, data protection, statistics, and ethics), and sociologists from the IRST Public Relations Office. The survey was built on an internally developed platform using the Streamlit framework [41], enabling a responsive and user-friendly experience on both desktop and mobile devices. A multilingual feature (Italian and English) facilitated potentially broader dissemination. The survey was voluntary and promoted across IRST and its affiliated sites from September 2023 to May 2024.

2.3. Survey structure

The online survey combined adapted items from prior research [38] with original questions, totaling 28 items across six sections: Demographics (4), Attitudes toward Data Protection (11), AI Knowledge (4), AI Concerns (3), AI Acceptability (3), and Domains of AI Application (3). Eleven questions required yes/no responses, six used a 5-point Likert-type scale, and the rest were single-choice, except for the final multiple-choice item. An introductory section outlined AI concepts, potential applications in medicine, and the survey's purpose. The questionnaire, included in Appendix A, was reviewed and approved for distribution by the IRST Public Relations Office, which paid particular attention to the wording of the questions to ensure neutrality and to avoid influencing patients' perceptions of risks and benefits. Ethical approval was not required, as participation was voluntary, anonymous, and devoid of personally identifiable information; survey completion implied informed consent.

2.4. Data collection procedure

Patients were recruited in hospital waiting areas and informed that participation was voluntary, anonymous, and unrelated to their care. Upon survey completion, they could optionally leave an email, stored separately, to receive study updates. To boost participation, posters with QR codes were placed in waiting rooms, staff promoted and assisted with the survey, and patient emails included the QR code and instructions in the footer.

2.5. Statistical analysis

Categorical variables were described as frequency and/or percentage and compared using a Chi-square test. All p-values were two-sided, and a $p < 0.05$ was considered statistically significant. Statistical analyses were performed with SAS 9.4 software (SAS Institute, Cary, NC, USA). Since

the platform required full completion of the questionnaire, no missing data were present.

3. Results

3.1. Demographic characteristics

Of the 569 patients who scanned the QR code, 117 completed the survey and were included in the analysis; 40 of them provided email addresses to receive study updates. Most respondents were women (59.0%) and belonged to the Boomer (48.7%) or Gen X (33.3%) generations (Table 1). Educational levels varied, with only 3.4% having completed primary school, while the majority had completed high school (41.9%) or held a university degree (34.2%). English proficiency was generally low: 53.0% reported no, beginner, or elementary-level skills (Table 1).

3.2. Attitudes toward data protection

Almost all respondents (94.0%) were aware of the European Data Protection Regulation (Fig. 1a). Regarding IRST's data protection notice, 18.8% signed it without reading, 41.0% skimmed it, and 35.1% read it carefully; however, 5.1% did not seek clarification despite having doubts (Fig. 1b). While 57.3% considered IRST's consent procedures well-structured, 40.2% felt they lacked sufficient knowledge to assess them (Fig. 1c). Most patients (76.9%) were willing to allow their data to be used for future research, compared to 12.8% who restricted usage to personal treatment and 10.3% who limited consent to specific studies (Fig. 1d). Similarly, 60.7% had no concerns about data sharing with other centers, while 37.6% were conditionally supportive if it contributed to oncology advancements; only 1.7% opposed any form of data sharing (Fig. 1e).

3.3. Knowledge of AI

The vast majority (95.7%) of respondents had heard of artificial intelligence, and a considerable group (70.0%) considered themselves able to define AI. About 41.0% of respondents used AI in professional or non-professional settings, while a notable portion (12.0%) were unsure if they used it. Before the survey, a large majority (85.5%) of respondents were aware that AI could be applied in the medical field (Fig. 2).

3.4. Concerns about AI

Participants expressed several concerns about the use of AI in medicine, particularly regarding reduced human interaction and potential physician overreliance (Fig. 3). While 56.4% reported little to no concern about AI implementation (25.6% minimal, 30.8% none), 27.4% expressed moderate to high worry. Opinions on patient–doctor interaction were more divided: 63.2% voiced concern that AI could reduce human contact with healthcare providers. Additionally, 52.1% feared that excessive reliance on AI might compromise clinical judgment.

Table 1
Demographic characteristics including age generation, gender, level of education, level of English proficiency.

Characteristics	Category	N = 117	%
Generations Age			
	Before 1946	6	5.1
	Boomers (1946–964)	57	48.7
	Generation X (1965–1980)	39	33.3
	Millennials (1981–1996)	12	10.3
	Centennials (1997–2010)	3	2.6
Gender			
	Man	47	40.2
	Woman	69	59.0
	Non - Binary	1	0.8
Level of education			
	Primary school	4	3.4
	Middle school	24	20.5
	High school	49	41.9
	University degree	40	34.2
Level of English proficiency			
	No knowledge	18	15.4
	Beginner	18	15.4
	Elementary	26	22.2
	Intermediate	39	33.3
	Advanced	16	13.7

3.5. Acceptability of AI

Despite some reservations, many respondents were open to AI if it improved medical decisions (57.3%), especially when physicians retained final authority (82.9%) and doctor-patient interaction was preserved (80.3%) (Fig. 4). These results highlight a nuanced view: patients value AI's potential for better outcomes but emphasize the importance of physician oversight and meaningful doctor–patient relationships (Fig. 4).

3.6. AI application

A majority of respondents (82.1%) supported using AI to enhance treatment success but preferred that doctors make therapeutic choices (Fig. 5). While 73.5% believed clinicians should hold full responsibility for AI-assisted decisions, 14.5% supported shared responsibility. Survey results identified areas suited for AI (Fig. 1 in Supplementary Materials): administrative management (61.5%), care pathway optimization (63.2%), and diagnostic support (53.8%) were most endorsed. Moderate support (32.5%) emerged for AI-assisted personalized treatment planning under guidelines, while 13.7% remained uncertain about AI's appropriate role in healthcare.

3.7. Associations

A comprehensive Chi-square analysis was conducted to assess associations between collected variables, although only statistically significant results are reported here.

A statistical association emerged between data protection concerns and willingness to share health data ($p < 0.0001$): patients worried about privacy preferred sharing data solely to improve their cancer care, while those unconcerned were more open to broader sharing.

Furthermore, findings suggested a significant association between AI utilization and age generation ($p = 0.012$), education ($p = 0.014$), and English proficiency ($p = 0.016$). Younger generations (Millennials and Centennials) reported greater AI use, both professionally and recreationally. Similarly, higher educational attainment and advanced English proficiency correlated with higher AI adoption: 60% among those with higher education and 81.3% among those fluent in English.

Conversely, older adults, less-educated individuals, and those with limited English skills reported lower AI use, possibly due to reduced exposure or familiarity with such technologies. This group also expressed greater concern about AI in healthcare ($p = 0.0240$), indicating a generational divide in attitudes and usage.

Lastly, educational level was significantly associated with views on responsibility for AI-assisted medical decisions ($p = 0.033$). Patients with higher education tended to assign full responsibility to physicians, while those with lower education (e.g., middle school) showed more varied views, with some still favoring physician responsibility.

4. Discussion

This is, to our knowledge, the first study conducted in Italy that, unlike previous works limited to specific domains such as radiology or breast cancer, investigates a broader oncology population across different care pathways while simultaneously addressing both AI and data protection. Our survey provides unique and timely evidence from a vulnerable group whose voices are often underrepresented in the debate on digital health innovation. These findings not only enrich the international literature but also offer a valuable perspective to inform strategies for the safe and patient-centered implementation of AI in oncology.

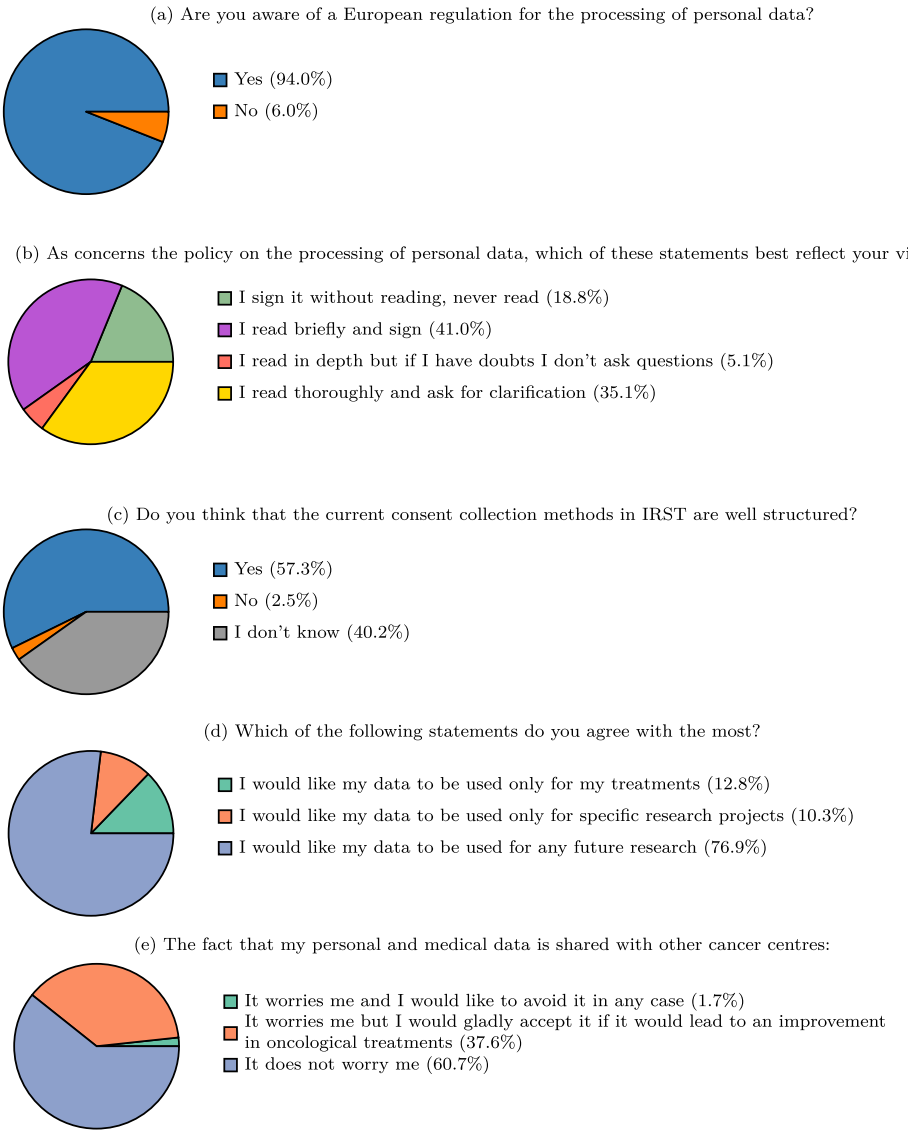


Fig. 1. Descriptive statistics of the data protection section, including clearance about European regulation, information on the processing of personal data, consent collection methods.

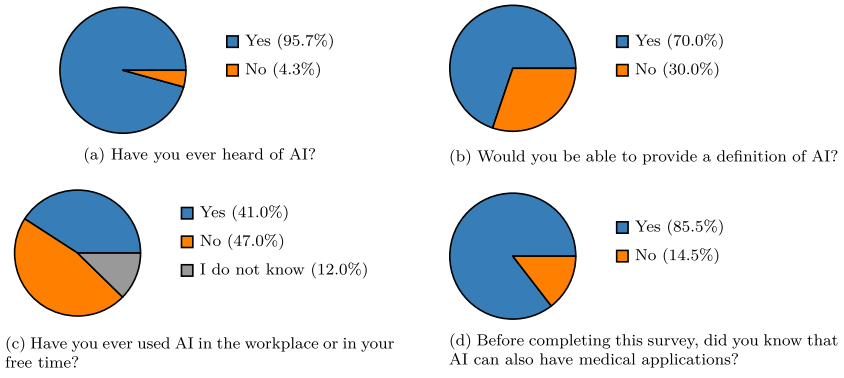


Fig. 2. Descriptive statistics on AI knowledge, definition ability, usage, and knowledge of its medical applications.

4.1. Privacy and attitudes towards data protection

Accurate AI algorithms require large amounts of data. However, privacy laws, while protective, can limit medical AI development. In our survey, 18.8% of respondents did not read information about data processing, and 41.0% only superficially read it. Nevertheless, 76.9% were willing to share their data for future research. Similarly, 60.7% had no

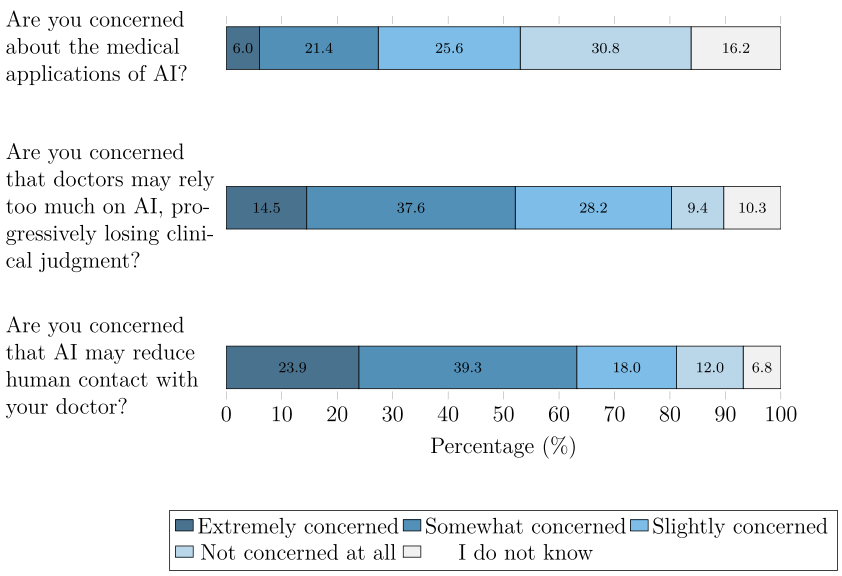


Fig. 3. Descriptive statistics of the AI concerns section, including concerns about using AI in the medical field, losing judgment by doctors and reducing human contact.

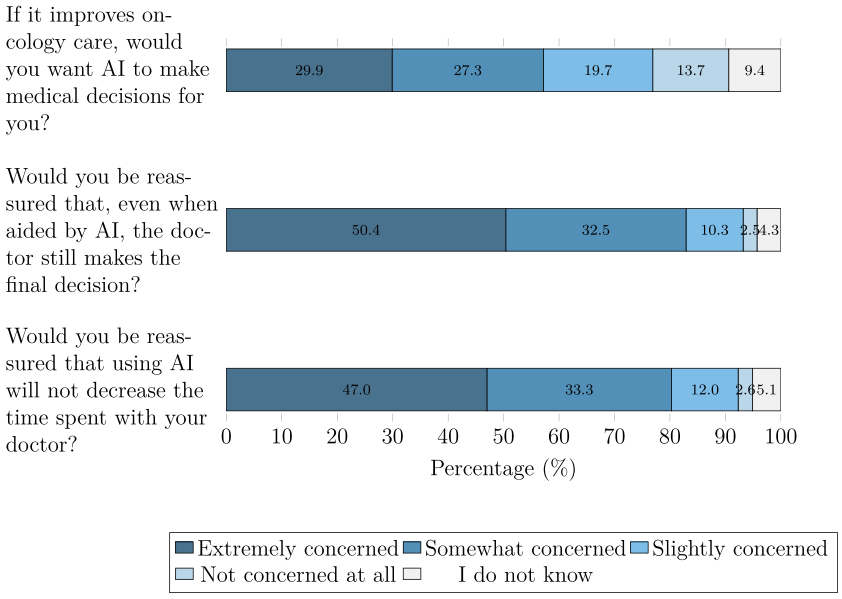
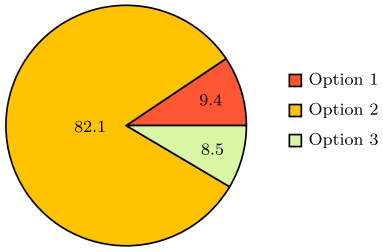


Fig. 4. Descriptive statistics of the acceptability section, including medical decision, final decision, and reassurance about time spent with the doctor.

concerns about data sharing across cancer centers, and even those initially worried generally supported data use when linked to improved care. These findings suggest that cancer patients prioritize oncology progress over strict privacy protection, likely due to limited data protection awareness and the psychological burden of cancer, which can lead patients to underestimate the personal and social risks associated with improper data use. Balancing patients' openness to data sharing with appropriate privacy safeguards remains a key responsibility for healthcare professionals.

4.2. Knowledge about AI and domains of AI application

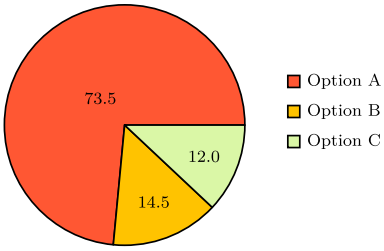
Compared to a 2021 survey where 23% of patients had never heard of AI [24], 95.7% of our respondents were aware of it; 70% claimed they could define it, and 85.5% recognized its medical applications. This higher awareness may reflect participants' education (41.9% high school diploma, 34.2% university degree), widespread exposure to tools like ChatGPT and growing media hype around AI, fueling public interest and potentially inflating perceived familiarity. However, only 41.0% used AI actively, suggesting that perceived familiarity doesn't equate to real understanding. Patients' prior encounters with technology and with the healthcare system likely also influenced their responses, contributing to the heterogeneity observed in our results. Older, less-educated, or non-English-speaking patients may feel less comfortable due to lower digital literacy and language barriers, which can lead to greater resistance to AI adoption. Since AI in healthcare is still a relatively new concept for most patients, our findings should be interpreted as capturing perceptions in evolution, rather than stable or consolidated attitudes. Addressing these disparities will require targeted educational initiatives, implementing digital literacy programs, and direct support from healthcare professionals.



Legend:

- **Option 1 (9.4%):** I prefer therapeutic choices to be made entirely by doctors and I would prefer AI not to be used, not even as an additional tool.
- **Option 2 (82.1%):** It is important that the therapeutic choices are made by doctors. However, I support the use of AI if it allows a greater probability of success in treatment outcomes.
- **Option 3 (8.5%):** If my probability of obtaining good results increases thanks to AI, I don't care whether it is accompanied by a medical opinion. This shows openness to fully automated systems.

(a) Which of the following sentences do you agree with?



Legend:

- **Option A (73.5%):** I would hold the doctor fully accountable for the decision.
- **Option B (14.5%):** I would hold the doctor only partially accountable for the decision made.
- **Option C (12.0%):** I do not know.

(b) If a decision was made regarding your treatment journey using AI, who would you hold responsible for that decision?

Fig. 5. Descriptive statistics of the artificial intelligence applications section, including preferences on responsibility for medical choices and the use of AI.

4.3. Concerns and acceptability

Previous studies report mixed patient views on AI, often influenced by survey design, framing, and varying levels of technological familiarity [36,38,42,43]. In our sample, most patients showed limited concern (25.6% little, 30.8% none), while 57.3% supported AI in medical decisions. Still, 27.4% reported some worry. Familiarity with AI (63.9%) was linked to lower concern. Key apprehensions included reduced physician contact (63.2%) and loss of clinical decision-making skills (52.1%). Physician supervision was strongly valued: 82.9% felt reassured when doctors retained decision authority, and 80.3% appreciated continued interaction. Only 8.5% supported AI-driven care without physician involvement.

Our findings confirm that even when AI supports therapeutic choices, most patients (73.5%) still hold physicians responsible, reinforcing their central role in AI acceptability [26,28,32,36–38,42,43]. A key obstacle to adoption is the "black-box" nature of many AI systems, emphasizing the need for explainable AI (XAI) [28,44,45]. XAI enhances transparency by clarifying how outputs are generated, enabling clinicians to understand, communicate, and take responsibility for AI-informed decisions. This transparency supports doctor–patient trust and aligns with Ploug and Holm's concept of "contestability" [46], advocating for patients' right to question AI decisions and promoting shared accountability.

This study has some limitations. Administering the questionnaire via QR code likely facilitated participation by younger patients with basic technological skills, contributing to the high AI awareness (95.7%). Patients born before 1946 were underrepresented. Nonetheless, the predominance of boomers and Gen Xers, common in clinical oncology, supports the findings' relevance. Participation was limited (117 completions out of 569 QR scans), which may reflect the fact that cancer patients are often physically or emotionally strained and therefore less inclined to engage in surveys. This low completion rate also raised the possibility of non-response bias, as patients who did not complete the questionnaire may differ systematically from those who did. Moreover, the use of QR codes in waiting rooms may have introduced a selection bias, favoring patients who were younger or more technologically skilled. Additionally, the complexity of the topic itself may have further discouraged participation, potentially introducing more biases. A further limitation concerns the potential influence of social-desirability bias, as some respondents may have provided answers they perceived as more acceptable or favourable. Similarly, the self-reported assessment of AI knowledge may not fully reflect participants' actual understanding, raising the possibility of an overestimation of awareness. Finally, the single-center design limits the generalizability of our findings. Future plans include simplifying the questionnaire and collaborating with other cancer centers to enhance representativeness and external validity.

4.4. Conclusion

In conclusion, this study represents the first Italian survey exploring cancer patients' attitudes towards AI and data protection. The results highlight that while cancer patients recognize the potential benefits of AI in healthcare, they also express concerns about reduced human interaction and the diminishing role of physicians in decision-making.

The findings underscore the importance of clear communication, education, and transparency to promote trust and ensure informed adoption of AI-driven solutions. To overcome the inherent limitations of closed-ended questions and capture a broader range of patient views, future versions of the survey could also include open-ended items. In such cases, advanced natural language processing techniques (e.g., topic modeling, sentiment analysis, or clustering) and dimensionality reduction methods such as PCA or embeddings could be employed to efficiently manage and analyze large-scale textual data. Future research should expand to multiple cancer centers to gather a more diverse patient perspective, enhancing the generalizability of the results and providing deeper insights into patient attitudes towards AI and data protection in oncology.

CRediT authorship contribution statement

Martina Cavallucci: Writing – review & editing, Writing – original draft, Software, Methodology, Data curation, Conceptualization. **Alice Andalò:** Writing – review & editing, Writing – original draft, Software, Methodology, Data curation, Conceptualization. **Valentina Danesi:** Writing – review & editing, Writing – original draft. **Nicola Gentili:** Writing – review & editing, Writing – original draft, Supervision, Software, Methodology, Conceptualization. **Ilaria Massa:** Writing – review & editing. **Emanuela Scarpi:** Writing – review & editing, Writing – original draft, Methodology, Formal analysis. **Maria Chiara Restuccia:** Writing – review & editing, Writing – original draft, Methodology, Conceptualization. **Roberto Vespignani:** Writing – original draft. **Alice Conficconi:** Writing – review & editing, Methodology. **Michela Palleschi:** Writing – review & editing. **Ugo De Giorgi:** Writing – review & editing. **Antonino Musolino:** Writing – review & editing. **Filippo Merloni:** Writing – review & editing, Writing – original draft, Supervision, Methodology, Conceptualization.

Declaration of generative AI in scientific writing

During the preparation of this work, the authors used ChatGPT - OpenAI in order to edit the draft and review grammar. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the published article.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at doi: 10.1016/j.ijmedinf.2025.106237.

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