Original Article

Patient Perspectives on the Use of Artificial Intelligence in Malignant Melanoma Diagnosis

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Abstract

Introduction: Early diagnosis of malignant melanoma (MM) is challenged by an increased incidence and a shortage of dermatologists. This has raised expectations on the use of artificial intelligence (AI) for diagnosing MM. Implementation of AI-based diagnostic tools rely on diagnostic performance as well as on patient trust and acceptance. Therefore, understanding patients' perspectives is essential when developing trustworthy AI-based diagnostic tools.

Objectives: The aim of this study was to investigate perspectives and expectations of AI-based computer-aided diagnosis (AI-CAD) for MM among individuals at high risk of developing MM.

Methods: An inductive qualitative study using an interpretive description methodology was carried out. Ten semi-structured interviews incorporating vignettes to investigate expectations regarding trust in AI, physician-patient interaction, diagnostic efficiency, and data security were conducted.

Results: Participants preferred AI being used as decision support for physicians. The interaction with a physician (human-in-the-loop) was deemed key to the experience of a proper diagnostic process, and participants recognized AI's potential to streamline the process.

Conclusions: Participants trust AI and recognize the potential of AI-CAD in the detection of MM. However, they emphasized the importance of human interaction as essential to a positive diagnostic experience. As trust is fundamental to safe implementation of new technologies in clinical practice, we recommend conducting post-market prospective studies employing a mixed methods approach. This will help ensure both patients' trust in the technology and physicians' confidence in its clinical utility.

Introduction

The incidence of malignant melanoma (MM) is increasing worldwide and expected to rise from 331,722 new cases worldwide in 2022, to 453,375 by 2045 [1]. This rise in incidence can be attributed to population growth, lifestyle changes with increased UV exposure, and an ageing population [2].

Early diagnosis of MM is correlated to positive treatment outcomes and favorable survival rates [3,4], but increased incidence, along with a growing shortage of dermatologists, challenges early diagnostics. Diagnosing MM is dependent on visual morphological features, and recognizing these specific MM features is a clinical task highly dependent on pattern recognition [5,6].

Convolutional neural network (CNN), a subtype of artificial intelligence (AI) particularly suited to visual pattern recognition, has shown potential to alleviate healthcare disparities surrounding MM diagnostics [7]. Several retrospective image analysis studies have demonstrated CNN to be superior to specialists in MM diagnosis and also the increased diagnostic precision of physicians using CNN [8-11].

Still, clinical implementation is lacking, partly as this is not dependent on diagnostic performance alone but also relies on patients' attitudes and trust in the technology [12-14]. Incorporating patients' perspective early in the development of AI-based diagnostic technologies can help ensure a clinical tool which patients find acceptable and trustworthy. This underlines the importance of patient involvement in the development of tools for AI-based computer-aided diagnosis (AI-CAD) [15-18]. Patients state that implementing AI in healthcare is inevitable and expect clinical AI to increase efficiency and address healthcare professional shortage[17,19-23]. However, concerns have been raised towards AI affecting patient trust in diagnosis, especially in an automated setting with no "human-in-the-loop" [17,19,22-24]. Using AI may also raise patient concerns with regards to data security and legal liability for diagnosis and treatment [15,17,19-21,23,24]. Additionally, trust in AI seems to be related to enhanced pathogenicity, as a study showed lower levels of acceptance of AI for diseases with a poor prognosis, such as MM [25].

Analysis of patient perspectives tends to be overlooked in the development of AI-based technologies in healthcare [12,16], and a scarcity of qualitative research also exists within the field of AI for diagnosing MM [22]. This study aimed to gain insight into patients' perspectives and expectations of using AI for MM diagnosis.

Materials and Methods

Design

A qualitative interpretive description (ID) methodology was utilized, using non-participant observation and semi-structured interviews which included vignettes. The ID approach was selected for its inductive and explorative nature, allowing researchers to create new or deeper insights into a clinical phenomenon with the aim of improving and qualifying healthcare [26,27].

To insure the transparency throughout this study, the standards for Consolidated Criteria for Reporting Qualitative Research (COREQ) guided the reporting [28].

Researcher Characteristics and Reflexivity

In qualitative research, the researcher's presence during data construction is unavoidable. To create meaning and achieve an understanding of patients' perspectives on the use of AI to make a diagnosis, an interpretation is required [27]. Interviews were conducted by authors K.L.M and L.S.B (hereafter referred to as the interviewers), neither of whom was familiar with the clinical setting or involved in the care of the patients. The interviewers were therefore able to approach the field without prior assumptions. However, to mitigate the risk that the interviewers may inevitably influence the research, reflexive practice was performed throughout the study. Reflexivity was maintained throughout the research process through regular reflections between the interviewers prior and during data collection to challenge assumptions and interpretations; the interviewers reflected on how their beliefs and pre-understanding could influence the data collection as well as analysis, whilst remaining cognizant of how participant responses could be influenced by their phrasing of questions or their mere presence.

Study Setting

The study was carried out in a University Hospital in Denmark, where patients were enrolled in a screening program for MM. Inclusion and exclusion criteria are presented in Table 1.

During the consultation, a dermatoscope and Canfield IntelliStudio™(Canfield Scientific; Parsippany, New Jersey, USA) were used for dermoscopy and full-body images. Though Canfield has built-in lesion severity assessment, it is authorized for research only and not currently used in clinical settings. Participants were included using purposive sampling strategy to achieve diversity in age and sex. Prior to data collecting, non-participant field observation was carried out with the purpose of gaining understanding of the clinical setting and the characteristic of the patient group.

Table 1. Inclusion and exclusion criteria.

Participants inclusion and exclusion criteria	
Inclusion	**Exclusion**
Patients age >18 years Enrolled in the screening program for MM at the Department of Dermatology (University hospital) Patients at risk of developing MM: Patients with FAMMM or genetic disposition[6] Patients with a history of MM[6] Patients with atypical nevi syndrome[6]	Do not speak or understand Danish

Abbreviations: FAMMM: familial atypical multiple mole melanoma, MM: malignant melanoma

Data Collection

Patients were invited to participate in the study during the consultation and provided signed informed consent. In total, eleven were contacted by phone and invited to participate in the interviews. One patient declined due to practical reasons. Semi-structured interviews (N=10) were conducted between March and April 2024 in the setting preferred by the participants [29]: either on Microsoft Teams™ (N=5), by phone (N=4) or face-to-face (N=1). The duration of the interviews ranged from 30 to 64 minutes, with a mean duration of 41.2 minutes (95% Confidence Interval–CI: 34.3 – 48.1).

An interview guide including the vignettes was developed based on the existing scientific literature, the study aim, and the non-participant fields observations.

Each interview started with open-ended questions about the participants' experience of current screening to take note of their history and individual perspectives. The interview continued in a more structured manner using vignettes, which are short stories and dilemmas about hypothetical situations [30]. Vignettes were considered relevant to the study, as AI is not currently implemented in clinical practice. Thus, it was essential to have scenarios that could depict concrete situations for the participants.

The vignettes were included as scenarios in the interview guide and were presented before several related questions. The interviews were audio recorded and transcribed verbatim.

Data Processing and Analysis

Using the ID analysis guidelines, a constant comparative analysis was conducted, allowing the interviewers to remain grounded in the data and refine or restructure codes and themes at any point during the analytical process [26,27] (Figure 1).

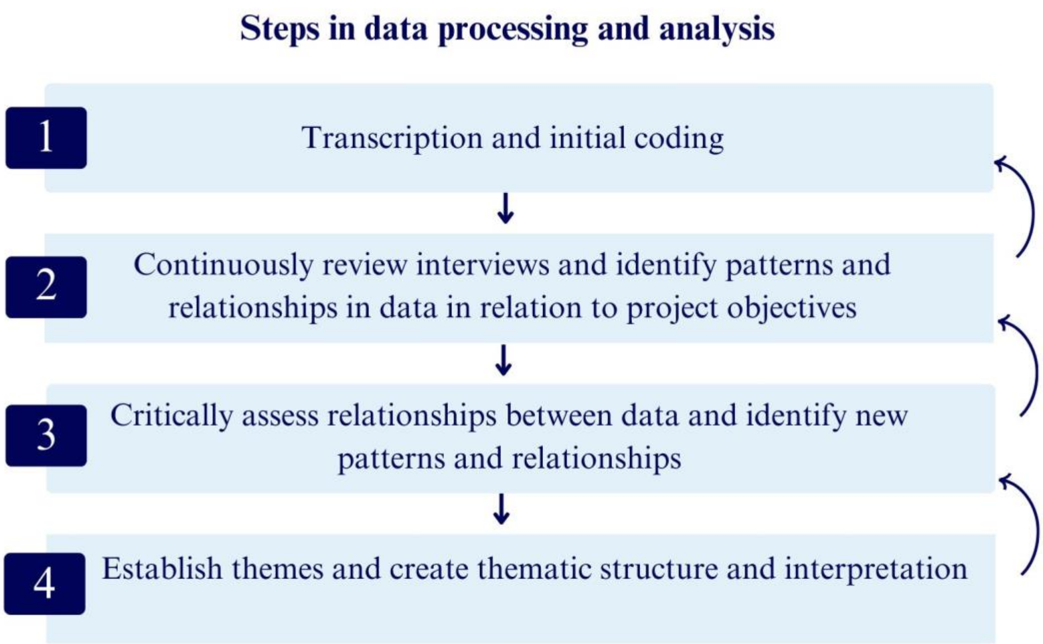

Figure 1. Overview of the study's data processing and analysis divided into four steps inspired by the ID approach [26,27]. Transcriptions were guided by a predefined template to ensure consistency and capture naive reflections. Data were repeatedly read, coded in NVivo14 (QSR International; Melbourne, Australia), and analyzed to identify patterns and key themes regarding participants' expectations of AI in melanoma diagnosis.

Descriptive data of the participants are reported as mean and 95% confidence interval (CI). Confidence intervals were calculated using the t-test.

Ethics

The study was conducted in accordance with the principles of the Declaration of Helsinki. All participants were recruited under written consent. The study was approved by the Central Denmark Region Committees on Health Research (ID 1-16-02-69-24). According to Danish Ethical Committee Law §14, subsection 2, ethical approval was not required.

Results

The participants had a sex distribution of seven females and three males, with a mean age of 49.5 years (95% CI: 41.5–57.5). In the study population, seven participants had a history of MM, and three participants did not (see Figure 2 for study demographics).

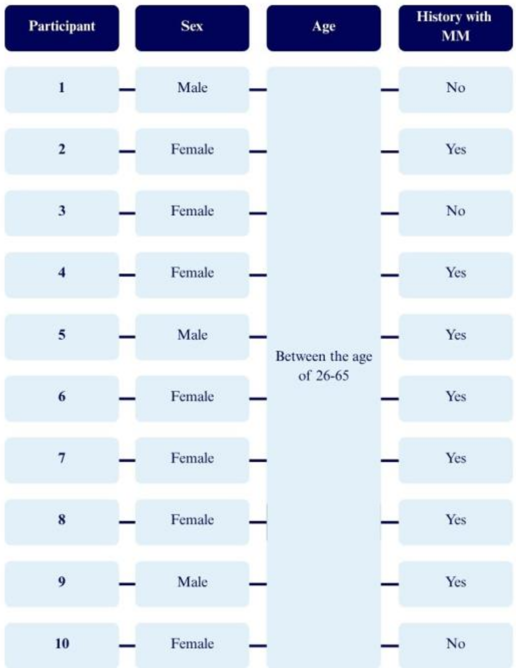

Figure 2. Overview of the demographics of the participants.

The analysis revealed four themes regarding perceptions and expectations of AI for diagnosing MM. See Figure 3 for themes and subthemes.

Key findings related to each theme will be elaborated in the following section, including the related subthemes. Selected quotes and vignettes from the four different themes and associated subthemes are shown in Tables 2-5. Participant IDs in the table are referenced in quotes.

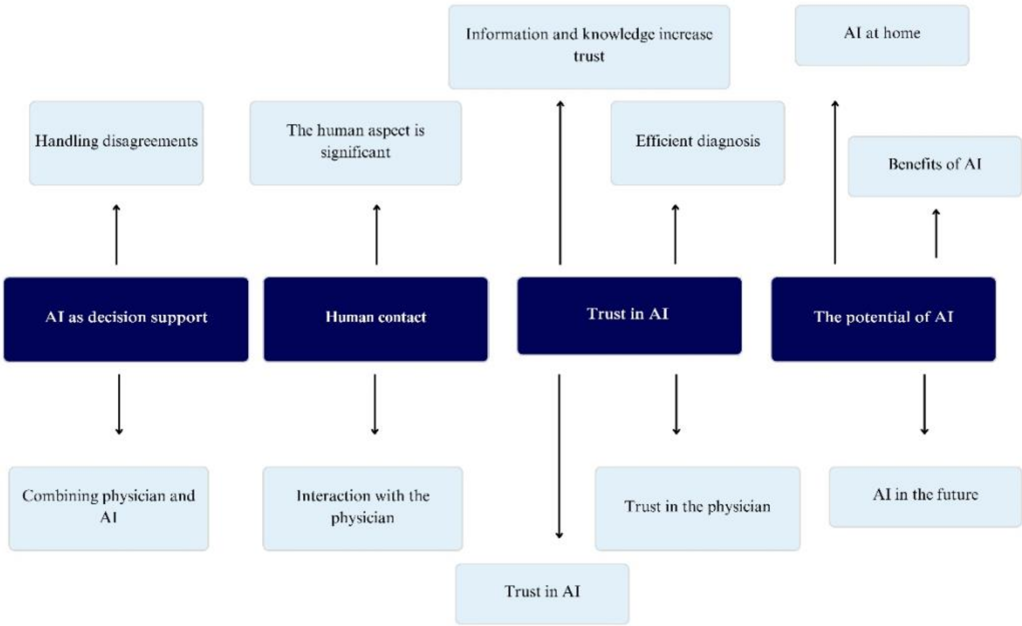

Figure 3. Identified themes and subthemes and their relations.

Table 2. Selected quotes from the themes and associated subthemes.

AI as decision support		
Subthemes	**Selected quotes**	**Vignette/question**
Handling of disagreements	*"… I would take the worst-case scenario… regardless of who says one or the other."* (P9) *"I believe I actually trust artificial intelligence more than the physician. However, if they disagree, I would assume that further examinations would be carried out in any case"* (P7)	Here's a different hypothetical scenario, which is related to the scenario where AI is used as a decision tool for the physician. Imagine that the physician and AI disagree about whether you have MM or not. What do you think about this? Do you think you would prefer to trust one over the other?
Combination of physician and AI	*"The combination of a human that understands and sees you as a person and a safe diagnostic tool – that is the ideal. Then it cannot get any better"* (P7)	How would your level of trust in the screening process be affected if AI were used as a decision-support tool for the physician? Would your level of trust increase as compared to current practice with only the physician involved?
Human contact		

Human interaction is valuable	*"I think that's the ideal because I think the machine is very safe, but a human can do something that a machine cannot do. The physician will see me as a whole person; the machine will probably only see pixels."* (P7)	Now imagine if the AI was used as a tool to help the physician assess your lesions. What do you think about the AI being used as a tool to help the physician assess your lesions?
Interaction with the physician	*It would take some getting used to … I couldn't ask the machine. Sometimes, I have a lesion that I'm not sure about … And I don't imagine I can talk to the machine about that, right?"* (P2)	How would it affect your confidence in screening if it is only AI that has assessed your lesions?

Participant IDs are referenced in the quotes, e.g. participant 1 = (P1). Abbreviations: AI: artificial intelligence, MM: malignant melanoma.

Table 3. Selected quotes from the themes and associated subthemes.

Trust in AI		
Subthemes	**Selected quotes**	**Vignette/question**
Trust in AI	*"I have very high trust in AI as a diagnostic tool for all kinds of diseases, whether it's life-threatening or not... I'm quite sure it's a perfect tool."* (P7) *"For example, this inside my ear, where I think, I'm not sure it would be able to see that. Or what about up on the scalp? Can it get through your hair? You also have lesions on your scalp. All the places that aren't quite so visible, does it see that?"* (P3)	Can you imagine that your confidence in AI diagnosis would be different if it was not potential cancer, but a non-life-threatening condition, e.g. eczema or a broken arm? Do you have any questions or is there anything we haven't talked about that you would like to add? How do you think AI will affect your consultation experience? Would it change anything in the encounter or relationship with the physician?

	"… if you could go to a center and pay with a coin or scan your health insurance card and afterwards get screened. I could probably be fine with that 30 years or so into the future…" (P1)	
Trust in the physician	*"Humans are also wrong. Humans are not 100% either."* (P7) *"I usually have great confidence in the physician who examines my moles"* (P1) *"I believe that when it comes to a human assessment, there will always be cases of doubt, which a person may interpret in one direction or the other. I do not think that a machine experiences the same uncertainty. For the machine, it is likely a matter of yes or no"* (P9)	Do you think there is anything that could help increase your trust in artificial intelligence even more?

Participant IDs are referenced in the quotes, e.g. participant 1 = (P1). Abbreviations: AI: artificial intelligence.

Table 4. Selected quotes from the themes and associated subthemes.

Trust in AI		
Subthemes	**Selected quotes**	**Vignette/question**
Fast diagnosis	*"Then I would take the opportunity to get it checked right away by whoever it might be."* (P9)	A future scenario where AI is scientifically studied and is better than the physician at assessing lesions for MM. Imagine you have discovered a mole that has changed. You are worried, so you contact the hospital department. It's Friday, and you are told

		that you would have to wait till next week for an appointment with a physician. But you are also told that it is possible to have photos taken inside the department by the AI machine, which then will assess your lesion. The AI machine is operated by a healthcare professional who is not a physician. This could be done the same day. What would you prefer in that scenario?
Information and knowledge increase trust	*"Yes please. The more knowledge I get about how it is, the more comfortable I become. I want to know how it works and get all the information I can get about it. It helps to make me feel more comfortable."* (P2)	How do you want information about a possible screening using AI? We still have this future scenario where AI is scientifically studied and has become better than the physician at diagnosing MM. AI is used in the department as a decision tool for the physician. Would you like to know if AI has been used to screen your mole?

Participant IDs are referenced in the quotes, e.g. participant 1 = (P1). Abbreviations: AI: artificial intelligence, MM: malignant melanoma.

Table 5. Selected quotes from the themes and associated subthemes.

The potential of AI		
Subthemes	**Selected quotes**	**Vignette/question**
Future prospects of AI	*"I have hopes that it will be part of screening in the future and that it will be able to help us a lot in this."* (P2) *"I think that's fantastic, and I think that's the very core of artificial intelligence… and of course, it also needs my data. That doesn't do me any harm."* (P7)	Have your expectations or thoughts about AI changed after this conversation? Imagine the scenario where AI is built into the photo machine. When the photo machine uses AI, it takes a series of pictures of you. When the photo machine assesses your images with artificial intelligence, it also uses your images to train itself to assess lesions, and in this way, it gets better. What do you think about this? What do you think about the photo machine saving your images and using the images to get better?

Advantages of AI	*"I think that the AI is just as capable of assessing these lesions as the physician is. It is not as subjective as the physician in the assessment of what it could be"* (P9) *"I am sure that you will discover more than when they are so busy … Yes, so I surely imagine that a combination can mitigate errors"* (P5)	The use of AI for melanoma screening has been scientifically studied, and AI is now more accurate than a physician in diagnosing melanoma. Now imagine a scenario where an AI photo machine was used instead of a physician to assess your lesions in the clinic. Your lesion is not assessed by a physician, but only by the AI photo machine. What do you think about the fact that the AI photo machine is assessing your lesions? In terms of your confidence in screening when the photo machine with AI is used as a support tool for the physician - what do you think your confidence would be like?

Participant IDs are referenced in the quotes, e.g. participant 1 = (P1). Abbreviations: AI: artificial intelligence.

AI as Decision Support

If scientifically proven that AI is better at assessing lesions than physicians, participants expressed that they would have the same or more trust in AI (Table 2). However, although the participants described having trust in AI, the combination of physician and AI was still preferred, as having both human and AI assessing the lesion increases trust in the diagnosis.

The participants stated that this combination would elicit the feeling of being "double-checked" during a consultation, which was perceived as a means to providing peace of mind.

In a scenario where the physician and AI disagreed on a lesion, participants did not trust the human nor the machine more, but instead wanted the lesion removed (Table 2).

Human Contact

Direct human contact was essential to the participants, as discussions with the physician provide an understanding of how they feel. The possibility to voice concerns and ask questions contributes to reassurance and the experience of high-quality care (Table 2). Some participants stated that healthcare professionals other than a physician could facilitate this human contact with the same effect.

Trust in AI

In general, participants had trust in assessing lesions with AI and understood that AI is not 100% accurate (Table 3).

The fear of MM was dominant among the participants, the reason why a quick clarification and diagnosis, even if this was initially automated with AI, was an attractive scenario to the participants (Table 4). However, participants indicated that they found a combination of AI and physician ideal.

Pathogenicity did not seem to affect trust unambiguously. Some participants reported having more trust when AI is used for conditions with a favorable prognosis, while others reported the same trust level regardless of the severity of the prognosis (Table 3). Although participants indicated that they found a combination of AI and physician ideal, several expressed that they could imagine AI being used for automated screening in the near future.

Trust was contingent on scientific validation of AI-CAD's diagnostic performance, with parity or superiority to physicians enhancing confidence. Participants also noted that greater transparency regarding the tool's function and clinical application would increase trust (Table 4).

Participants emphasized the importance of physicians demonstrating transparency regarding the use of AI-CAD for MM, particularly during early implementation. Trust in AI was also influenced by media portrayals, with success stories enhancing acceptance.

Finally, several participants expressed concern that AI may neglect less accessible anatomical areas, a concern that reinforced their preference for AI as a decision support tool (Table 3).

The Potential of AI

AI was regarded as a promising healthcare innovation, with participants expressing enthusiasm for AI-CAD implementation in MM screening (Table 5). Several were willing to actively support software development to improve diagnostic accuracy, and all accepted the use of their clinical images for training future CNN models for MM diagnostics (Table 5).

Further benefits from AI were expressed. Firstly, efficiency and addressing resource shortages were key benefits. Secondly, participants expressed seeing AI being used for automated screening for MM as well as a potential for home screening. Finally, participants felt that AI could mitigate the intra-observer variability due to time constraints, cognitive load, or other human factors, expecting more consistent assessments and a lower risk of misdiagnosis with decision support tools (Table 5).

Discussion

The participants in the study expected and preferred AI to be a decision support tool for the physician, which correlates with previous studies [17,21,31]. Furthermore, the findings indicate that combining AI with physician's input promotes human involvement and communication. This addresses patients' common concern about reduced human interaction, a concern supported by several studies [14,15,19,20,22,23,32]. The importance of human involvement is further emphasized by the critical role of a thorough medical history and phenotypical evaluation of the patient, which are important factors in determining a lesions risk of MM [33]. These risk assessments could be performed by a multimodal model including both specific medical history data and patient reported outcomes. However, experience from questionaries' regarding self-assessment of risk factors for MM have shown that patients tend to underestimate their own health risks [34,35].

Participants also favored combining physician and AI to increase trust and to mitigate intra-observer biases. These results also coincide with those from other studies, where some patients felt safer if the physician used AI as a support for diagnosis rather than AI alone [15,21,23,31].

The participants indicated that physicians' age and experience level could affect their trust in the diagnosis and perceived value of using AI-CAD. These findings are supported by retrospective head-to-head studies, which show an increased diagnostic performance of physicians when utilizing decision support tools for MM diagnosis. This was more pronounced for non-dermatologists and residents of dermatology [11,36,37]. Such findings could indicate that AI as a decision support tool might not only improve physicians' diagnostic performance but also patients' trust in the correct diagnosis. Furthermore, subjects expressed anticipations for AI-CAD to up-qualify non-dermatologists, such as medical students or nurses, to conduct MM screening. AI-assisted care was seen as preserving human interaction regardless of clinician experience, supporting the upskilling of non-specialists in MM diagnostics. By up-qualifying non-specialized personnel for MM screening with AI-CAD, the shortage of specialized physicians could be addressed. When upskilling personnel with decision support tools, device- and circumstance-specific training in the use of said tools should be clearly defined.

Participants emphasized that trust in AI could be increased by being informed about the evidence supporting its use. Specifically, precision of the AI technology was a concern, as low diagnostic precision increases risk of erroneous diagnosis [22]. This highlights the importance of democratic interpretability of the statistical results when disseminating information to patients regarding AI tools. It also underlines the importance of transparency in AI development and educating commercial and political stakeholders on expert group guidelines for training and testing AI-CAD in dermatology [38]. Attention must be given to the limitations of clinical AI use, including confirmation and automation bias, and to whether its training and testing environments reflect real-world clinical settings [13].

The participants expressed general positivity towards clinical implementation of AI as a means to streamlining the diagnostic process. Supporting this, a study revealed increased diagnostic speed as one of the most commonly perceived benefits of AI in skin cancer screening among patients [22]. AI-CAD implementation for MM screening has raised concerns that AI–physician discrepancies could increase biopsy rates, burdening patients and pathology workflows. Our study showed that participants preferred a biopsy if the physician and AI disagreed, consistent with earlier results [22]. This would hypothetically lead to a significant number of biopsies done solely as a protocol event and not because of confirmed suspicion. Such clinical behavior leads to unfavorable effects on the positive and negative predictive value of the AI-based tool [39]. As histology is not always unambiguous, borderline cases will result in increased histopathologically misdiagnosed MM. In addition, the rise in unwarranted biopsies of benign lesions would pose a burden to the healthcare system. Thus, AI should not be used indiscriminately as a screening tool [39]. To avoid confirmation and automation biases when using AI, the physician should also have a plan on how to handle a potential disagreement. These measures could help to mitigate the challenge of human-AI disagreement of MM assessment.

Participants recognized that AI is not 100% accurate, just as humans are not. However, it is important to assess the context in which AI performs better than humans, and if the data can be generalized to all MM phenotypes. This is relevant, as clinical morphology of MM is dependent on the patient ethnicity, skin tone, and the anatomical site of the lesion [3,5]. An important finding was the participants' concerns regarding AI's potentially neglecting less accessible lesions, such as in the ear canal or the scalp. This has not been highlighted in previous literature on the use of AI in diagnosing MM. Addressing this relevant concern of physical limitations in accessing certain anatomical regions is a finding of increasing importance, with the future of MM screening moving towards 3-dimensional imaging modalities. This finding underlines the importance of disseminating limitations and proper use of AI-CAD for MM diagnostics to the end user. Furthermore, informing patients about such technical limitations helps alleviate identified concerns with regards to both limitations and diagnostic efficacy. The concern raised on lesion site also indirectly addresses a core clinical challenge in MM diagnostics, as morphological features of MM and nevi varies across different parts of the body. In general, clinically representative input data, such as data of specific anatomical locations, are key for high performing models in live clinical settings [5]. This showcases the importance of data transparency in development of AI-CAD for MM diagnostics to ensure that model training has been conducted on representative input data with regards to anatomical sites, lesion types, and population demographics.

Another interesting finding was that the participants were comfortable about sharing their data to facilitate the training of AI-based tool and had minimal concerns regarding data sharing and data security. This aligns with other studies showing broad, albeit conditional, support for health data sharing, tempered by concerns over confidentiality and misuse [40].

The general willingness of the subjects in our study to share data could be related to the age of our participants (mean age of 50 years), as higher age has been associated with increased support for data sharing [40]. The nationality of our study population could also contribute, as Danes, who live in a universal welfare state, are well-known for their high level of trust in authorities [41].

The heterogenicity of the study population with regards to MM history was a limitation to this study. While all participants were at risk of developing MM, seven out of ten had a prior history of MM. As disease severity has been found to influence acceptance of AI-CAD [25], a severe event such as prior history of cancer could have the same effect. The difference in personal experiences as well as the small sample size reduce the internal consistency of the results and could limit the external generalizability to either group. However, we found no difference in responses when stratified with regards to prior history of MM.

Prior research on AI-CAD for MM has predominantly focused on head-to-head studies in a "Man vs. AI" approach [8,42-44]. The present findings suggest that future quantitative research should prioritize investigating a more collaborative approach, i.e., "Man and AI" such as the study conducted by Tchandler et al. [36]. Successful implementation of AI in clinical practice depends not only on diagnostic performance but also on patient trust and user confidence [45]. Future research should prioritize prospective intervention studies using a mixed method approach to evaluate real-world performance and explore both patient and clinician perspectives. High quality study designs in generalizable settings ensure trust, usability, and clinical confidence in AI-based solutions [45].

Conclusion

The present study aimed to explore perceptions and expectations of patients at high risk of MM regarding using AI as a diagnostic aid in screening for MM. Participants trusted the ability of AI to diagnose MM but preferred AI to be used as a decision support tool for physicians and not as a replacement. Overall, participants saw the potential of AI in MM diagnostics, enabling greater security in diagnosis and freeing up human resources.

These findings relate to the future implementation of AI for diagnosing MM. Prospective qualitative studies conducted in clinical settings are necessary to assess patients' and healthcare professionals' perceptions of AI, which can help the implementation and use of AI in clinical practice.

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