

# Journal of Medical Screening

## Screening participants attitudes to the introduction of AI in breast screening

Journal:	<i>Journal of Medical Screening</i>
Manuscript ID	JMS-20-258.R1
Manuscript Type:	Letter to the Editor
Date Submitted by the Author:	08-Feb-2021
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Keywords:	breast cancer screening, mammography, artificial intelligence
Abstract:	<p>A shortage of radiologists is increasingly putting the UK breast cancer screening under strain. One possible partial solution is the use of Artificial Intelligence (AI) in a screening context to meet this future need. Significant strides have been made in advancing the possible use of Artificial Intelligence in breast cancer screening, mostly using retrospective studies. However, little is known about breast cancer screening population views on the use of AI in interpreting breast screening mammograms.</p> <p>We conducted a survey assessing the views and attitudes of breast screening participants regarding the use of AI in breast cancer screening, by presenting them with a number of scenarios detailing the possible clinical use of AI clinically.</p> <p>Overall there was high levels of acceptance of AI in the assessment of breast cancer screening mammograms, particularly where there remained a human screen reader assessing images. However, in scenarios where human readers were replaced showed no overall acceptance. We assessed participants self-assessed understanding/knowledge of AI. Interestingly, increasing levels of self-assessed understanding of AI correlated with higher levels of acceptance of its use clinically.</p>

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3 **Letter to the Editor**  
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6 **Screening participants' attitudes to the introduction of artificial intelligence**  
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8 **in breast screening**  
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33 [Abstract – ? n/a for Letter to Editor]  
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3 A shortage of radiologists is increasingly putting UK breast cancer screening under  
4 strain <sup>1</sup>, and with more breast radiologists retiring than new radiologists being  
5 appointed/trained <sup>2</sup> this burden is set to increase. One possible partial solution is the  
6 use of artificial intelligence (AI) in breast screening mammogram interpretation to meet  
7 this future need. Various groups have demonstrated the potential use of AI in  
8 retrospective studies although few have demonstrated its utility, in situ, in large  
9 prospective randomised control trials <sup>3-5</sup>, the conventional way of demonstrating clinical  
10 and operational utility.

11  
12 The next step in this technology's evolution is to determine how best to implement it.  
13 Should AI replace all human readers, partially replace them, or operate as a reader  
14 assistant/companion? Population screening relies on the test (and its interpretation)  
15 being acceptable to those participating <sup>6</sup>. However, little is known about the views of the  
16 breast cancer screening population on the use of AI in interpreting breast screening  
17 mammograms. Data published recently from a Dutch survey of women aged 16-75 does  
18 demonstrate overall good acceptance of AI especially when used alongside human  
19 screen readers <sup>7</sup>.

20  
21 In October 2020, using a standardized paper questionnaire, we sought to obtain NHS  
22 Grampian screening participants' views on the use of AI in interpreting breast screening  
23 mammograms, with the aim of designing a prospective study agreeable to the screening  
24 population. The questionnaire was designed with help from social scientists and  
25 reviewed by University of Aberdeen ethics committee. Its execution was aided by a local  
26 charity/patient group and tested for clarity in a similar population to our sample. The  
27 complete questionnaire is available in the supplementary material and on our study  
28 website (<https://icaird.com/about/public-engagement>).

29  
30 After describing the current UK system of dual reader screening followed by arbitration  
31 reading if required, we posed four different AI scenarios and asked participants whether  
32 they approved or objected; 364 consecutive screening participants were offered the  
33 questionnaire, and 187 (51%) returned completed responses. Responses to the four key  
34 questions can be seen in Figure 1. We tested the differences in approval/objection for  
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3 those that expressed a preference (not neutral) using a Chi-squared approach.  
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5 Participants significantly approved of the introduction of AI for three out of the four  
6 scenarios presented. These scenarios involve both AI and human readers to varying  
7 degrees. Of these three scenarios, AI as a reader companion (Scenario 4) and AI  
8 replacing one human reader (Scenario 1) met with the most approval, while AI as a  
9 triage tool (Scenario 3) met with less approval. On average, participants neither  
10 approved nor disapproved of the boldest option (Scenario 2), the complete replacement  
11 of human readers. In addition to the scenarios, we asked participants their age;  
12 perceived knowledge of AI; and if they had a family history of breast cancer. Those with  
13 greater self-assessed knowledge of AI were more likely to approve of its introduction.  
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15 Family history of breast cancer showed no association with AI approval. Age had a weak  
16 positive association with approval for Scenario 3, AI as a triage tool.  
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25 The gains of each scenario are yet to be quantified; however, it is clear from these results  
26 that most of the screening population approves of (or does not object to) the  
27 introduction of AI techniques for breast screening. This approval is larger in a  
28 subsample who have some self-perceived knowledge or understanding of AI. It is our  
29 understanding that these are the first published data demonstrating the effect that  
30 perceived understanding of AI has on the likelihood of acceptance of AI within breast  
31 cancer screening mammography. However, the level of perceived understanding may be  
32 a function of other factors such as education or socioeconomic status. For this reason,  
33 the generalisability of our finding may be limited to similar populations. Taken  
34 together, the more potentially disruptive the AI scenario (i.e. less human involvement),  
35 the lower the level of approval. This is to be expected with the service and the population  
36 entering an exciting but uncertain phase, until in-situ knowledge and confidence are  
37 gained with AI tools. The more acceptable scenarios may well be stepping stones to a  
38 bolder use of AI with potentially more service gains in the future.  
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50 Acknowledgements: Innovate UK has funded this research under the UK Research and  
51 Innovation Industrial Strategy Challenge Fund. We are grateful to Friends of Anchor for  
52 supplying single-use pens for participants to complete the questionnaires. We would  
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3 also like to thank the participants and staff at the breast screening unit in NHS  
4  
5 Grampian.

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8 References

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11 1. Gulland A. Staff shortages are putting UK breast cancer screening survey finds.  
12 *BMJ* 2016; 353: i2350.  
13  
14 2. The Royal College of Radiologists. Clinical radiology UK workforce census 2019  
15 report. Report, The Royal College of Radiologists, London, April 2020.  
16  
17 3. McKinney SM, Sieniek M, Godbole V, Godwin J, Antropova N, Ashrafiyan H, et al.  
18 International evaluation of an AI system for breast cancer screening. *Nature*  
19 2020; 577(7788): 89–94.  
20  
21 4. Rodriguez-Ruiz A, Lång K, Gubern-Merida A, Broeders M, Gennaro G, Clauser P,  
22 et al. Stand-Alone Artificial Intelligence for Breast Cancer Detection in  
23 Mammography: Comparison With 101 Radiologists. *J Natl Cancer Inst* 2019;  
24 111(9): 916–22  
25  
26 5. Sasaki M, Tozaki M, Rodríguez-Ruiz A, Yotsumoto D, Ichiki Y, Terawaki A, et al.  
27 Artificial intelligence for breast cancer detection in mammography: experience of  
28 use of the ScreenPoint Medical Transpara system in 310 Japanese women. *Breast*  
29 2020 ;27(4): 642–51  
30  
31 6. Wilson JM., Junger G. The principles and practice of screening for disease. World  
32 Health Organisation, Geneva, 1968.  
33  
34 7. Ongena YP, Yakar D, Haan M, Kwee TC. Artificial Intelligence in Screening  
35 Mammography: A Population Survey of Women’s Preferences. *J Am Coll Radiol.*  
36 Epub ahead of print 12 Oct. DOI: 10.1016/j.jacr.2020.09.042  
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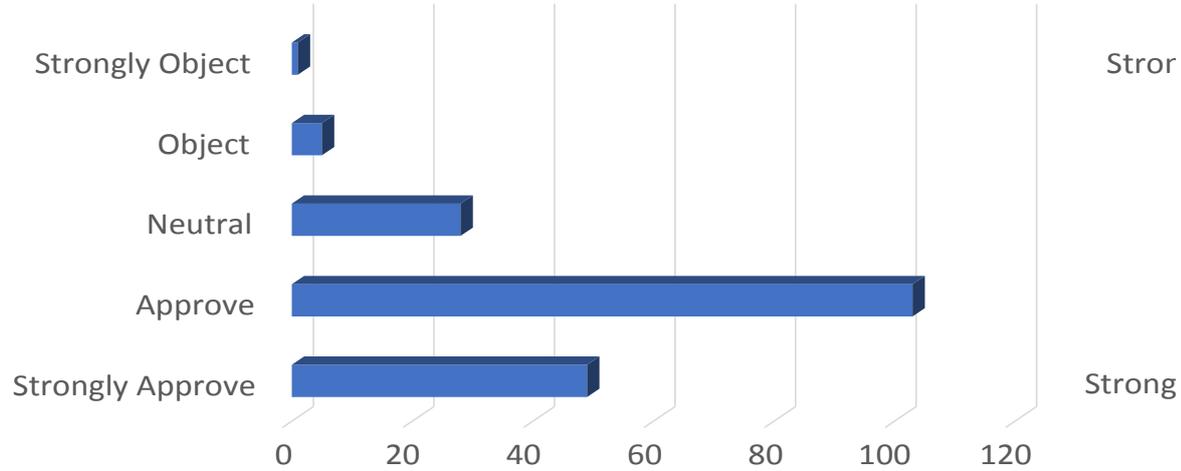
Figure 1. The acceptability of different strategies for the introduction of AI into a dual reporting breast screening service.

[Figure – can be reproduced in greyscale for print issue, no color charge]

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### Scenario 1: AI as a partial replacement

Instead of two specialists examining your mammograms, a specialist and the AI examine your mammograms. If they disagree, a different specialist will make the final decision

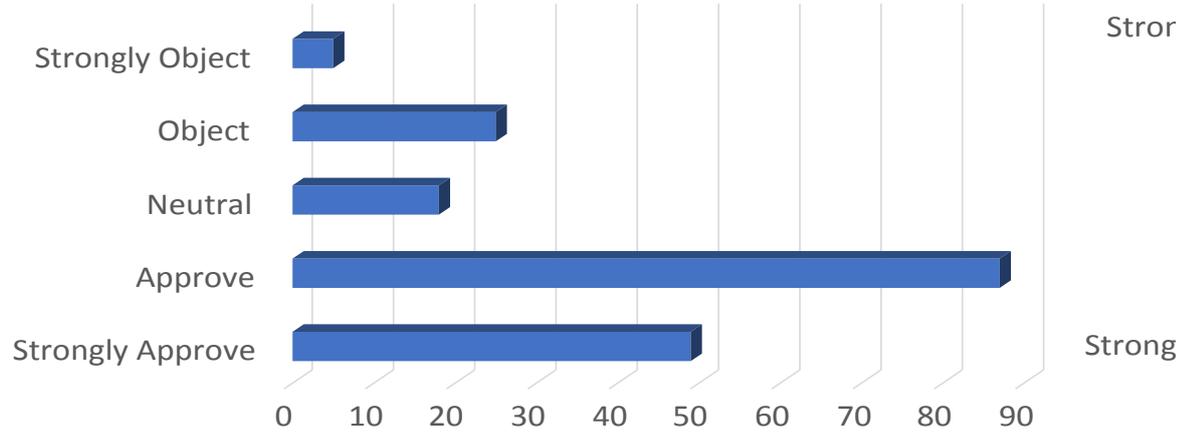


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### Scenario 3: AI as triage

The AI examines your mammograms – if the scan is very likely to be normal you are not invited back for further investigation. If the AI is unsure or the image appears abnormal a human specialist will also review your image

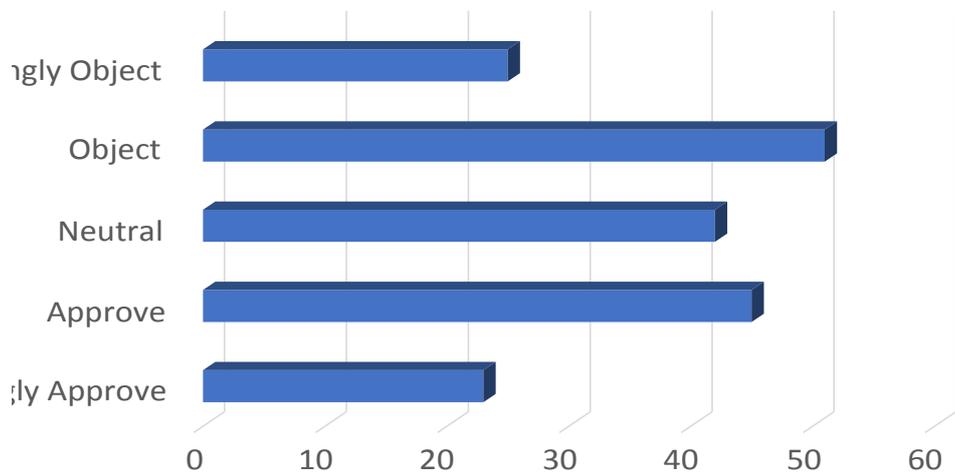


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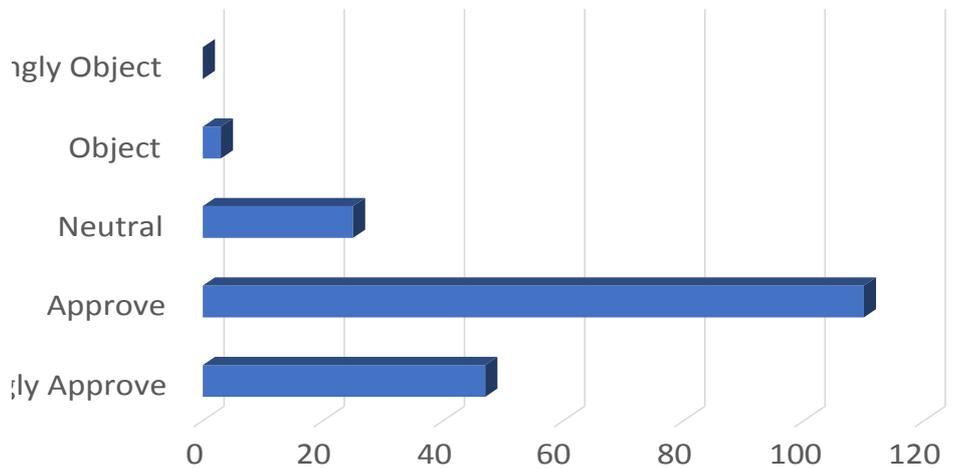
Scenario 2: AI as a complete replacement

The AI examines your mammograms without input from specialists and decides if you are invited back for further investigation



Scenario 4: AI as a reporting companion

All mammograms continue to be examined by specialists as is the current practice. They have access to an AI to help them make their decision



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## Breast screening participants' views on artificial intelligence for breast cancer screening

We would like to find out your views on the use of artificial intelligence for breast cancer screening.

Taking part is **voluntary** and your responses will be completely **confidential**. None of the health care professionals involved in your care will know whether or not you have responded. If you have any questions about this survey, you can contact Dr Clarisse de Vries at: telephone xxxxxxxxxxx, email xxxxxxxxxxx.

In the future, an artificial intelligence (AI) computer program could examine a person's breast X-ray images (mammograms).

Currently, two specialists examine a person's mammograms. They both give their opinion on whether the person should be invited back for additional exams. If they disagree with each other, a third specialist decides.

Below are a few scenarios on the use of AI in breast screening. Please circle the opinion that most closely reflects your views.

- 1. Instead of two specialists examining your mammograms, a specialist and the AI examine your mammograms. If they disagree, a different specialist will make the final decision**

*Strongly Object*      *Object*      *Neutral*      *Approve*      *Strongly Approve*

- 2. The AI examines your mammograms without input from specialists and decides if you are invited back for further investigation**

*Strongly Object*      *Object*      *Neutral*      *Approve*      *Strongly Approve*

Please turn over to complete



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3. **The AI examines your mammograms – if the scan is very likely to be normal you are not invited back for further investigation. If the AI is unsure or the image appears abnormal a human specialist will also review your image**

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*Strongly Object      Object      Neutral      Approve      Strongly Approve*

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4. **All mammograms continue to be examined by specialists as is the current practice. They have access to an AI to help them make their decision**

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*Strongly Object      Object      Neutral      Approve      Strongly Approve*

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5. **If the use of an AI would lead to faster screening results, would you be more likely to object to or approve of any of the above scenarios?**

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*More likely to Object      No influence      More likely to Approve*

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Please tell us about yourself by answering the following questions.

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6. **How old are you?**

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*50-54      55-59      60-64      65-70      Older than 70*

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7. **Do you have a family history of breast cancer?**

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*Yes      No*

- 45  
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8. **Is this your first breast screening visit?**

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*Yes      No*

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9. **My understanding of artificial intelligence is:**

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*Very Poor      Poor      Average      Good      Excellent*

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Thank you very much for your time.