



Attitudes to multi-cancer early detection (MCED) blood tests for population-based screening: A qualitative study in Great Britain

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ABSTRACT

Background: Trials are underway to test the clinical utility of multi-cancer early detection (MCED) blood tests for screening asymptomatic individuals. We sought to understand the acceptability of MCED blood test screening and potential barriers and facilitators to participation among the general public.

Methods: We conducted eleven semi-structured online focus groups with 50-77-year-olds ($n = 53$) in April–November 2022. Participants were purposefully sampled to include a mix of socio-economic and ethnic backgrounds as well as people who would not want ‘a blood test for cancer’. Participants were shown information about MCED blood tests. Transcripts were analysed using reflexive thematic analysis.

Results: Participants showed enthusiasm for MCED screening. Perceived benefits included procedural familiarity and the potential to screen for many cancers. Enthusiasm was driven by beliefs that cancer is a real and increasing risk (both at population level and personally with age) and that early detection reduces treatment burden and cancer mortality. Some felt they would not want to know if they had cancer. The potential for MCED tests to raise anxiety was a concern, especially in a false-positive scenario. Participants wanted to avoid unpleasant and unnecessary procedures. The initial blood test was deemed “less invasive” than current screening tests, but potential follow-up procedures were a concern. Views on MCED screening were influenced by wider factors including dislike of uncertainty, desire for choice and control over one’s health, and existing relationships with the NHS.

Conclusion: The introduction of MCED screening is likely to be appealing due to the simplicity and familiarity of the primary test procedure. Test accuracy needs to be high to facilitate acceptability and should be communicated from the outset. Some people would rather not know if they have cancer, and MCEDs will not appeal to all.

1. Introduction

Multi-cancer early detection (MCED) blood tests interrogate circulating tumour DNA and other biomarkers in a blood sample, offering the opportunity to detect early signs of many cancers. Several MCED tests are currently being developed and some can indicate where in the body a cancer might be (tumour origin) to direct follow-up tests (Klein et al., 2021). MCED tests vary in specificity, sensitivity, underlying biological mechanisms and number and type of cancers detected (Hackshaw et al., 2022). These tests show promising potential to detect clinically significant cancers without increasing overdiagnosis (Chen et al., 2021) and to support clinical decision-making in symptomatic referral contexts

(Nicholson and Lyratzopoulos, 2023). It is still unknown whether these tests will be used to screen asymptomatic individuals at a population level.

Cancer screening identifies early signs of cancer, and in some cases pre-cancerous conditions, in asymptomatic people to promote favourable cancer outcomes such as reduced cancer mortality and treatment burden. The World Health Organisation recommends population-based screening for breast, bowel and cervical cancer (World Health Organization WHO, 2022) and lung cancer in high-risk individuals (World Health Organisation WHO, 2023). Where offered, these programmes are estimated to save thousands of lives annually (Richards, 2019); however there are still many cancers that are not screened for, including

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aggressive cancers like pancreatic and stomach cancers. MCED population-based screening could overcome this by providing a test for multiple cancers.

The NHS-Galleri trial (NCT0561162) launched in 2021 and aims to establish whether one MCED blood test (Galleri®, GRAIL, LLC) can reduce late-stage cancer incidence in asymptomatic individuals. Internationally, this trial will be the first to provide evidence of the clinical utility of MCEDs in population screening (Neal et al., 2022). Modelling studies estimate that an MCED national screening programme could prevent thousands of cancer deaths each year in England (Sasieni et al., 2023); however if implemented, high, equitable uptake will be vital for its success. Understanding the acceptability of new screening tests in target populations is crucial prior to implementation (Dobrow et al., 2018). While MCEDs are being developed for urine, stool, saliva and breath samples, this study focused on blood-based MCED screening which is the most common approach (Kessler et al., 2023). Features of MCED blood tests, including the procedure, possibility of screening for many cancers, and the potential for complex and varied follow-up will likely influence their acceptability and will have implications for informed decision-making and uptake (Marlow et al., 2022).

This study sought to explore the acceptability of, and attitudes towards future population-based MCED blood test screening and to understand potential barriers and facilitators to participation in the likely target population. We drew on recent theoretical conceptualisations of acceptability as a multi-faceted construct including attitudes, beliefs about ethicality, perceived effectiveness and anticipated burden of participation (Sekhon et al., 2017). We also used the COM-B model (Michie et al., 2014), to consider possible contextual and individual level factors that might influence decisions about MCED screening participation. The COM-B model suggests behaviour is influenced by multiple factors: Capability (psychological and physical ability to participate), Opportunity (external factors that make behaviour possible) and Motivation (processes inspiring behaviour). To date, this is the first study to explore the acceptability of MCED population-based screening.

2. Methods and materials

We have reported the methods and results of this study following the consolidated criteria for reporting qualitative research (COREQ) checklist (Tong et al., 2007) (Supplementary Table 1).

2.1. Participants

Eleven online focus group discussions were held with men and women aged 50–77 years ($n = 53$). This age-range reflected the age-based eligibility for the NHS-Galleri trial. Two recruitment agencies purposefully recruited participants from Great Britain representing a range of characteristics including socio-economic status (SES; measured using occupational social grade (Office for National, 2021); high SES = social grades A, B or C1; low SES = social grades C2, D or E) and ethnicity (Table 1). Those that had had cancer in the last three years were excluded since a recent cancer diagnosis would likely make them ineligible for MCED blood-test screening (Neal et al., 2022). Individuals who had participated in the NHS-Galleri trial were also excluded. We wanted to include the views of those less positive about screening, so two groups were purposefully recruited to include people who said they would ‘probably not’ or ‘definitely not’ have a blood test for cancer. We also wanted to include the views of those from ethnic minority backgrounds, so four groups were recruited to include people exclusively from Asian/Asian British and Black/Black British backgrounds.

Potential participants were identified through the recruitment agencies’ panels and were emailed a screener questionnaire (available at: <https://osf.io/rpz72/>) to complete if interested in participating. This included questions about social grade, age, gender, ethnic background, occupation, highest level of education, time spent living in the UK,

Table 1

Inclusion criteria for the eleven groups.

Group #	n	Sex	Social grade ^a	Ethnicity	Screening attitudes/behaviour
Group 1	5	Male	Low	Any	Any
Group 2	5	Male	High	Any	Any
Group 3	4	Mixed	High	Any	Any
Group 4	5	Female	High	Any	Any
Group 5	5	Female	Low	Any	Any
Group 6	5	Male	No requirement	Any	Would not have a blood test for cancer
Group 7	4	Female	No requirement	Any	Would not have a blood test for cancer
Group 8	6	Female	No requirement	Black/black British	At least half NOT “always” screening attenders
Group 9	6	Female	No requirement	Asian	At least half NOT “always” screening attenders
Group 10	4	Male	No requirement	Black/black British	At least half NOT “always” screening attenders
Group 11	4	Male	No requirement	Asian	At least half NOT “always” screening attenders

Note: Groups 1–7 were recruited through a UK-wide recruitment agency and groups 8–11 were recruited through an agency that specialises in recruiting participants from ethnic minority backgrounds.

^a High socio-economic status (SES) = social grades A, B or C1; Low SES = social grades C2, D or E.

geographical location, employment status and previous cancer diagnoses. We also asked about participants’ previous screening behaviours, knowledge of the NHS-Galleri trial, and intention to have a blood test for cancer if it were offered.

2.2. Materials

The focus groups were semi-structured. Firstly, participants discussed their general attitudes towards cancer screening. A short statement introducing MCEDs was then read aloud. Next, initial views on MCEDs were discussed before presenting participants with further information about how MCED screening might work (read aloud and shared on screen; Box 1). A final set of information was presented regarding more practical aspects (i.e., making and getting to appointments). The information presented to participants was developed by the research team and patient and public involvement (PPI) representatives by adapting the NHS-Galleri trial participant information sheet (originally created by behavioural science researchers with PPI input). The facilitators used a topic guide throughout the groups which included prompts to discuss potential barriers and facilitators to participation, and elements of the Theoretical Framework of Acceptability (Sekhon et al., 2017) and COM-B model (Michie et al., 2014). At the end of the focus groups, participants were able to ask questions. All groups were audio recorded.

Box 1

Information provided within the focus groups

Short statement about MCEDs:

A multi cancer early detection (MCED) test is a new type of test that looks for potential signs of cancer in a blood sample. This is sometimes called a liquid biopsy.

Additional information about MCED Screening:

- The test itself would be like a normal blood test where a small tube of blood is taken from the arm.
- When a person has cancer, the cancer can release small pieces of DNA into the bloodstream. MCED tests look at patterns of markers on the DNA to flag a possible cancer signal.
- These tests can pick up the signal for more than 50 different types of cancer, including many of the cancers for which there are no screening programmes, such as lung, pancreas, or stomach cancers.
- The signal does not mean that a person definitely has cancer. It just means that they might have cancer, and that they will need to have some follow-up tests at a local hospital to see if they actually have cancer.
- About half the people who have a cancer signal will be found to have cancer during the follow-up tests, and the other half will not. If the test does not pick up a cancer signal this does not rule out cancer completely. The test is meant to be used alongside normal cancer screening.

Practical Information:

- The test would probably take place at your GP surgery.
- You would have to book an appointment online or over the phone
- Get to the appointment
- Have an appointment that lasts about 10 min and includes a normal blood test (about one-and-a-half tablespoons, 20 mL of blood).

2.3. Procedure

Data collection took place from April to November 2022. All groups were held online and had four to six participants, in line with best practice for online focus groups (Brown, 2022). The groups were facilitated by the authors: LM (n = 6), NSB (n = 4) and JW (n = 1), with at least one other author present. A medical student joined one group to observe. Participant information sheets and consent forms outlining the procedure and funding source were sent and returned before the groups (see: <https://osf.io/rpz72/>). Data on participant characteristics was provided by the recruitment agencies including details collected through the screener questionnaire and data held on record about the participants. At the beginning of each focus group, the facilitating researcher reiterated that the research was funded by a company developing an MCED test but described the research team as independent and emphasised our interest in understanding both positive and negative views.

The recruitment agencies paid participants £40 for taking part in line with their standard incentive payment procedures. The study was approved by King's College London Ethics Committee (ref: LRM-22/23-28381).

2.4. Analyses

Recordings were transcribed verbatim by an external agency and checked by NSB. Once transcribed, identifiable information was removed, and each participant was assigned a pseudonym.

The transcripts were analysed by NSB using Reflexive Thematic Analysis (Braun et al., 2019). Firstly, NSB familiarised herself with the transcripts by reading and checking each one. NVivo 1.7 was used to organise and facilitate coding. NSB generated initial codes for the first five groups through inductive coding. Mind-mapping and post-it notes were used to organise these codes into initial themes (both semantic and latent) (Byrne, 2022). The remaining six groups were coded inductively, with new codes created when needed. After all 11 transcripts were coded, themes were refined. Semantic themes were defined and organised using a mind map. NSB then returned to the latent themes and refined these based on the semantic theme map. The themes were presented and discussed in detail with LM and JW regularly throughout the

analysis and discussions fed into the refinement of themes through an iterative process.

2.5. Reflexivity

All researchers were female, had previous experience of facilitating focus groups, and did not have prior relationships with the participants. As researchers with backgrounds in psychology, we consider ourselves to be critical realists in our approach to understanding attitudes, beliefs, and experiences of public health. We consider these concepts to be complex, and open to social and political influence. Our research uses a range of methodological approaches, as we contend that the 'reality' of public health interventions can only be known through reported cognitions and behaviours, mediated through social determinants of health and contextual factors. At the time of data collection NSB, LM and JW were a research assistant, senior researcher, and reader in cancer behavioural science respectively. LM and JW had PhDs in health psychology and NSB had an MSc in health psychology.

All group facilitators (LM, NSB and JW) wrote reflexive statements before the study started and kept reflexive journals throughout data collection. The researchers reflected on their pre-existing conceptions before the groups and initial responses to the discussions. NSB added to this journal throughout the analysis to document the development of themes and her thoughts on how her own personal background and views might impact the analysis. When refining the themes, NSB revisited the journal entries and considered these when developing the themes. A reflexive summary is available on request.

2.6. Patient and public involvement

A PPI panel consisting of five participants was involved in the development of the participant information sheet, consent form and topic guide. The panel met online before recruitment for the study started and gave feedback on draft documents. Feedback from PPI representatives resulted in wording changes to simplify the language in the information sheet and consent form. We also made changes to the text providing information about MCEDs based on their suggestions. Preliminary findings were shared with the panel at a later meeting and some of their thoughts inspired points in the discussion section of this paper.

Table 2
Characteristics of participants (n = 53).

	n
Sex	
Male	25
Female	28
Age	
50-59	27
60-69	14
70+	12
SEG	
A/B (least deprived)	13
C1	14
C2	10
D/E (most deprived)	16
Ethnicity	
White (British, Irish, Other)	24
Mixed	1
Black (Caribbean, African, Other)	10
Asian (Indian, Pakistani, Bangladeshi)	18
Length in UK	
All my life	34
More than 10 years	18
Less than 10 years	1
Highest level of education	
No formal qualifications	2
GCSE/O-level/CSE	12
ONC/BTEC	6
A-levels or equivalent	8
Degree or equivalent	25
Screening attendance	
Never heard of cancer screening	1
Heard of cancer screening but never invited	18
Invited for cancer screening but have never done it	7
Invited for cancer screening but not done it every time	10
Invited for cancer screening and done it every time	16
I decline to answer this question	1
Heard of NHS-Galleri trial	
Never heard of the NHS-Galleri trial	45
Heard of the NHS-Galleri trial but not been invited	6
Been invited to take part in the NHS-Galleri trial but decided not to participate	2

3. Results

3.1. Sample characteristics

Overall, 53 people took part. Four additional participants gave consent but did not attend the focus group. The reason for their non-attendance was unknown. Participant characteristics are presented in Table 2 and broken down by focus group in Supplementary Table 2. Participants were female (n = 28) and male (n = 25), with a mean age of 60.5 years (range 50–76). Participants were spread across social grades (n = 13 A/B, n = 14 C1, n = 10 C2, and n = 16 D/E). Most had some formal qualifications (n = 51) and 25 had a degree or equivalent. Participants were from a range of ethnic backgrounds; 24 were from white ethnic backgrounds, and 29 were from other ethnic backgrounds. Most participants had taken part in screening before (n = 26) but of these some had not always taken part (n = 10) and seven had been invited but never taken part in screening (n = 7). The focus groups lasted 51–85 min and were conducted in English.

3.2. Thematic structure

A schematic representing the overall structure is presented in Fig. 1. Discussions about MCED screening included semantic themes, where participants balanced the perceived benefits and concerns about MCED screening (inner circle in Fig. 1). These discussions took place within the context of more latent themes driven by personal priorities in relation to health, and relationships with the NHS (outer circles). Themes and subthemes are described below. Details in parentheses following quotes

represent the participants' sex (M = male/F = female), age (years) and group number (G#): [sex, age, group number]. Additional illustrative quotes are presented in Supplementary Tables 3 and 4. All quotes presented are verbatim.

3.3. Views on MCED screening

Generally, participants showed enthusiasm towards MCED screening. Some said the potential introduction of MCED screening made them “really emotional” and having this type of test would be “a no brainer”. Many showed an immediate desire to participate after being given the initial statement about MCED screening, with participants saying “it’s brilliant”, “I’d go for it straight away” and “really happy to have the test”. Others showed more cautious interest and hoped that they would receive information about the “pros and cons” before deciding whether to take part. Some said they “wouldn’t be interested in something like that”.

Enthusiasm for MCEDs was driven by several factors including procedural familiarity, the potential to detect many cancers, the belief that cancer is an increasing risk and perceived benefits of early detection. Concerns about MCED tests included anticipated anxiety and the potential need for invasive and unpleasant procedures.

3.3.1. Procedural familiarity

Blood tests were considered a well-known, “standard” procedure. Most people described having had blood tests before, meaning they would be confident to have MCED screening. Participants said that many people aged 50–77 would have blood tests regularly, so to “add another one in” would not cause inconvenience or additional stress. Blood tests were recognised as quick and “very simple” with limited risks and “no horrors”.

“It’s easier than going for a mammogram, to be honest, if all you’ve got to do is just go along for an appointment, give some blood and they can tell a number of things from that. I can’t think of an easier process.” [F, 64, G9]

Participants’ views on how MCEDs could be delivered also reflected an inclination for familiarity. Some said they would like MCED screening to occur in mobile clinics, like mammograms, since this was “such a good system”. However, some participants from ethnic minority backgrounds raised concerns around data security in mobile clinics and felt this setting could make individuals feel “less important as a patient” compared to hospitals or purpose-built clinics.

“But when it’s, as you say, in a little caravan, you know, in some car park, you just kind of feel like, you know, you just feel a little bit demotivated, or not demotivated, dehumanised, kind of a little bit.” [F, 50, G8]

Some said they would prefer MCED screening to take place in primary care, since this setting was familiar, and the nurses knew how to take their blood “so they don’t give me bruises”. The COVID-19 pandemic was described as offering familiarity with alternative delivery options including pop-up clinics, online booking systems and text-message invitations, which could be used for MCED screening.

“That’s why I said it depends, you know, exactly how they’re going to roll it out, whether it’s gonna be like the COVID thing. You know, they were going to have tents set up where people formed an orderly queue. Or if you’d actually have to, you know, make an appointment like with your GP, which is nigh on impossible nowadays.” [F, 57, G5].

Nevertheless, participants stressed that not everyone can use online booking systems and text-message invitations so it would be important to offer alternatives.

“So, we’d have to think of how this could be delivered and whether it could be like the COVID vaccination programme. Like to get these

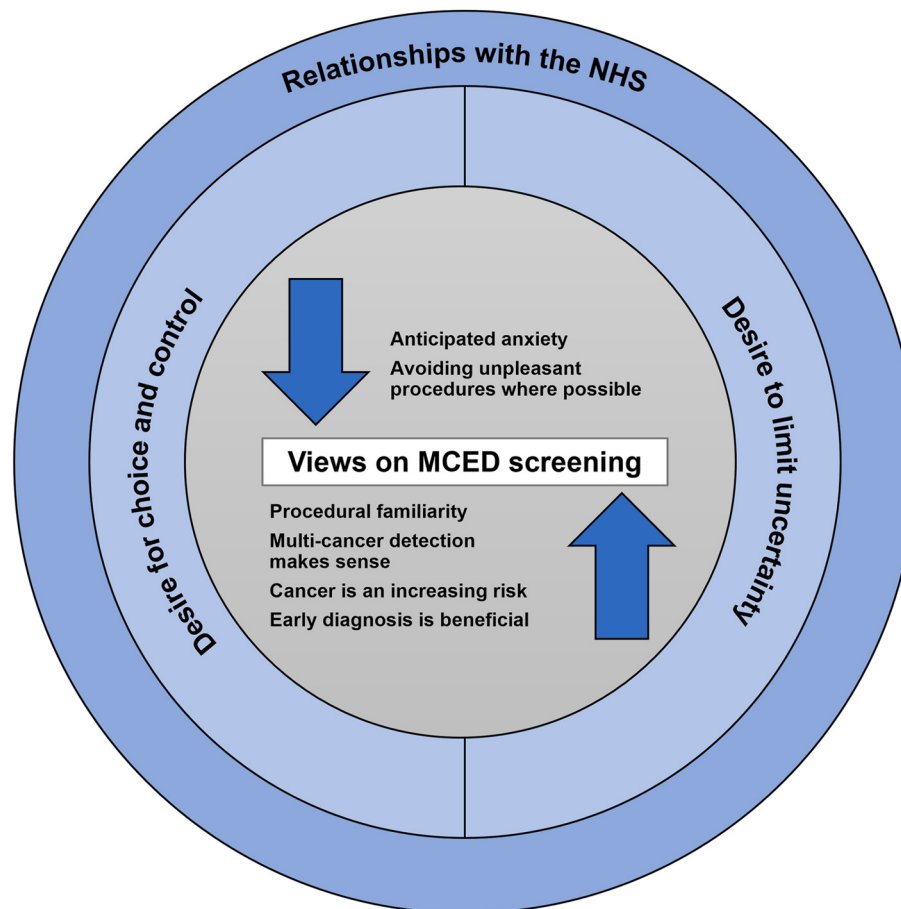


Fig. 1. Schematic of semantic and latent themes. The inner circle contains semantic themes relating to perceived benefits and potential concerns about MCED screening. The outer circles represent latent themes that influenced participants' views.

sort of blood centres popping up in places where all day, every day people are just taking blood to do these tests." [F, 54, G4]

3.4. Multi-cancer detection makes sense

Participants were "shocked" that "one blood test" had the potential to detect up to 50 cancers. This was described as "almost unbelievable", and participants were pleased that many types of cancers could be detected through MCED screening. Participants said that screening for many cancers at once could give "peace of mind" and that a negative result could "make you feel well".

"You're always thinking about other types of cancers and to have a test, even if it's a low proportion that go on to have cancer. To have that peace of mind is a massive thing as well. It's not just finding people early so that you can treat them early and save money that way, which it will do but also to give people peace of mind." [F, 58, G4].

Some were disappointed that MCEds might not replace current screening programmes, but others said MCEds could work alongside current screening to offer "more ammunition" (against cancer). Some said that a negative MCED screening result would make them feel reassured that they are clear of many cancers especially after the age of eligibility for other screening programmes.

"I'd like to think it was more accurate, but I suppose if you went for your cervical and then you went to your breast screening. You know, it's probably, if the blood test wasn't 100 percent accurate, then you've got two chances of finding it." [F, 53, G5]

Participants thought screening for multiple cancers could save

money. Some said they would expect the test to "cover the most common cancers", and others hoped the test would screen for cancers they felt personally at risk of due to family history. Participants also raised questions about how the "accuracy" of the test varied for each cancer type.

"The only thing I would question is, in terms of going back to the question of accuracy. When we're talking about finding these markers would it be different percentages for different cancers? Like, say, cervical cancer is 80% accurate, for lung cancer would it be 60% accurate." [F, 58, G8]

3.4.1. Cancer is an increasing risk

Participants generally feared cancer and were concerned about their personal risk which motivated enthusiasm for MCED screening. Cancer was seen as an increasing threat, both in terms of its population-level prevalence, and personally with older age. Some feared cancer so much that they would not say the "big 'C' word". For some participants, lifestyle factors and family history of cancer heightened cancer risk perceptions and seemed to motivate enthusiasm for screening in general.

"I'm scared for cancer, breast cancer. Because my sister, elder sister, have a cancer last year. I'm very scared." [F, 52, G9]

For others, cancer was not the biggest worry and other health concerns (e.g., dementia) were described as "more scary". For these participants death was inevitable, but maintaining integrity in later life was a priority meaning they were less afraid of their risk of cancer, and therefore less motivated to find cancer early.

"I want to know that I will die with my mind functioning properly. I don't want to be in a care home, I don't want dementia, don't want Parkinson's. So, I wouldn't take the test because I'd rather die of a cancer than ... [have] ... medical science extending and extending my life, to make my body work when my mind isn't working." [M, 65, G6]

Some participants felt at low risk of cancer so said MCED testing was unnecessary for them. These individuals said they may "not bother" with an MCED if they did not have symptoms, demonstrating a misunderstanding of the asymptomatic nature of screening. Others cited more spiritual beliefs and said that God was protecting them, meaning there was no need for a test.

"What you're telling me is you're inviting people just generally to do a test ... well, there's nothing wrong with me. So, I'm just going to crack on and not bother, right?" [M, 55, G1]

3.4.2. Early detection is beneficial

Across the groups there was a general belief that "any screening is good". Beliefs about the benefit of early detection fuelled enthusiasm for MCED screening which participants felt would be an effective way to find cancers early. Early detection was described as a way to "get it [cancer] when it's an acorn before it turns into a massive tree" and "key to beating this damn thing." Some argued that early detection meant cancer is easier and cheaper to treat and can reduce treatment burden and disruption to daily life.

"Dealing with things in an early stage in cancer is often simpler than late stage, less operations, less aesthetics, less things that disrupt your life. So if you are going to do interventions, do them early." [M, 65, G6]

Others said that early detection is only of value when there are "actual cures" so that people can go "back to normal health" and said that some cancers were not curable.

"But I'm quite happy to do it, because things like bowel cancer are curable if they're caught quickly, if they're not caught early, then they tend to be lethal." [M, 71, G1]

Testing the blood for early signs of cancer was described as making sense. Participants could see how cancer might show up in the blood before symptoms or visible tumours developed, meaning MCED tests could promote earlier detection.

"From my knowledge, spiritual knowledge ... blood is very important. The blood tells you everything about the person ... And if you're going to detect cancer, you know, earlier or anything, it has to be from the blood, so I think it's on the right track." [M, 56, G10]

3.4.3. Anticipated anxiety

The potential for MCED testing to raise anxiety was a key concern discussed in all groups. Waiting for MCED screening results could be a "worrying" time due to the "not knowing" and a positive result was expected to cause anxiety, particularly when waiting for follow-up tests to verify cancer status.

"Because my anxiety would be through the roof. I'll be thinking all the time, Oh, my Gosh, I might, or I might not. So, all that waiting would be quite nerve wracking." [F, 51, G8].

Some said the anxiety of waiting for results from follow-up tests would be more harmful than the benefits of early detection and this would be a barrier to participation. To reduce anxiety, "speed is of the essence" when conducting follow-up tests and sharing these results. Participants also emphasised the importance of providing detailed information about what to expect and next steps. Despite these periods of waiting being highly stressful, most thought this would be "worth it" for the chance to find cancer early.

"Certainly a big part of the paperwork needs to be what happens after the test, depending on, you know" [66, M, G2]

Participants suggested that "the chance of ... a cancer that's been missed" could cause worry or delayed help-seeking if symptoms arise. They said a "false positive" could cause significant "unnecessary" anxiety, and even anger.

"Yeah, if I was extremely busy one week, and I felt a pain in my stomach, then it might just tip the balance for me not to seek help very quickly. I might think I'll put it off for it until next week or the week after." [M, 57, G3]

Some were concerned that they might undergo invasive tests only for no cancer to be found and said this would break their trust in MCED screening, resulting in future non-participation. For others, the possibility of a false positive result was considered necessary and acceptable when balanced with the benefits of detecting cancer early. Some said that if they were to receive a positive screening result, but cancer wasn't found, this might lead to them "living in fear" that cancer might "manifest" in the future, potentially unnecessarily.

"And the other side of the coin is actually it was a negative. I don't have cancer. You may have had that period of time when you were stressed, but what a relief it will be to know that you actually haven't got cancer." [M, 62, G11]

3.4.4. Avoiding unpleasant procedures where possible

Individuals had varying views on medical procedures, but generally said "the less invasive, the better" with a desire to reduce the number of unpleasant procedures needed to screen for cancer. Blood tests were considered less unpleasant and invasive than existing screening methods like mammography and speculum cervical screening.

"It's certainly the simplest and quickest form of testing, isn't it? I mean, you don't have to undress and be humiliated by the doctor poking you, and all that sort of stuff." [M, 60, G2]

Some said they were afraid of blood and needles and would rather avoid blood tests. However, most accepted that cancer screening can be unpleasant and that if a blood test for cancer were offered, they could "close my eyes and turn my head", because the benefits would outweigh the unpleasantness of the blood test.

"I do struggle. Sometimes they end up like a pin cushion. But I'd rather have that because it's less intrusive. Even though sometimes it's very difficult to get my blood." [F, 58, G4]

The potential for MCED screening to find cancer earlier and reduce the need for more intensive and unpleasant treatments such as chemotherapy was seen as a benefit. For some, the prospect of unpleasant medical procedures if cancer was found was a barrier to MCED screening. These participants felt they would not want to know if they had cancer since they would not accept certain cancer treatments.

"I wouldn't want to be screened for everything. I wouldn't want to go through very long cancer treatments. I've seen many friends go through." [M, 65, G6]

Some said they would be hesitant to have more invasive follow-up tests following a positive result in MCED screening, since these risked physical and psychological harm. Nevertheless, most said that they wouldn't "have a choice" but to go for the follow-up tests if they had a positive MCED screening result.

3.5. The wider context

Views on MCEDs sat within a broader context of personal experiences and preferences. These included a desire to limit uncertainty, a desire for personal choice and control, and relationships with the NHS.

3.5.1. A desire to limit uncertainty

Uncertainty could cause anxiety and consequently participants described a desire to reduce uncertainty. MCEDs were seen as providing an opportunity to reduce uncertainty by offering a familiar procedure (i. e., a blood test) in a familiar setting (i.e., GP or hospital). Participants said cancer can “strike” unexpectedly and remain undetected due to ambiguous or late-stage symptoms.

“When we go for test, we only go a few different type of cancer test, but we don’t know any other cancers like those symptoms or the effects on your body or anything.” [F, 62, G9]

Most said they would rather know if they had cancer, and MCEDs offered an opportunity to reduce uncertainty in relation to their cancer status for many cancers at once. Conversely, some were content with not knowing their cancer status and said they would be happy to live in “blissful ignorance”.

“I just wanna – I like to face things head on, you know, like, whatever it is, you just deal with it, you know, whatever your dilemma, just get on with it you know.” [M, 55, G1]

Participants had lengthy discussions about potential uncertainty following an MCED test result, which was influenced by perceptions of how “accurate” the test would be. Participants were told that around 50% of those with a positive MCED screening result would have cancer found (see [box 1](#)) and some saw this as “better than we have now” since “no test is perfect”.

“Yeah, well, there’s no test that’s 100% effective. Even if you have a mammogram or a smear test, they’re not 100% effective. We’re just trying to catch things that you can early and an additional screening would help to do that. And then you get referred on to see someone to narrow it down. Either way, it’s still a good idea.” [F, 58, G4]

Others found this accuracy rate highly problematic, saying this was “on the par with fortune telling” and would need to “vastly improve” for them to consider MCED screening. A small number of participants felt MCEDs would be “pointless” and not cost-effective without a “conclusive” result.

“It’s kind of saying, okay even if it’s a general cancer, we’re not guaranteeing you haven’t, But even if it does, we still can’t guarantee it. So ... What would be the main point of it?” [M, 50, G11]

Participants said that it would be key to communicate the possibility of false negatives and positives to those offered MCED screening for transparency.

“If you know it’s not accurate or else you may not pursue tests and look for other things in your body. And then it turns out you have got it ... I’d like to know the degree of accuracy.” [F, 70, G3]

3.6. A desire for choice and control

Participants described wanting choice and control in relation to their health. An unexpected cancer diagnosis was something that could limit sense of control, and cause worry. MCED screening was seen as a positive way to take control over one’s health and risk of cancer, by identifying cancer at an early stage and offering greater choice in cancer treatment.

“Well, I think it’s fairly important to have early diagnosis of anything, because then you have the time to think through possible treatments and investigations.” [M, 73, G6]

The desire for choice and control extended to discussion around implementation of MCED screening. Participants said they would rather book their own appointments or have walk-in centres at different locations so they can control their own schedule. Participants held varying views on how MCED screening results should be communicated and felt

individuals should be given a choice of how to receive their results.

“We live in this culture of ... on-demand and everything has got to work the way you work and if ... this kind of testing can be incorporated and someone that wants to go and do it at the time that suits them ... at ... their own convenience.” [M, 50, G1]

3.6.1. Relationships with the NHS

In all groups, perceptions of the NHS impacted participants’ feelings about MCED screening. There was a desire for NHS endorsement, and the NHS logo was considered a sign of thorough evaluation.

“If it’s got the NHS logo on it, then for me, it’s been rigorously tested ... it’s passed all the things it needs to do.” [M, 66, G2]

Some trusted that the NHS would treat any diagnosed cancers quickly, but others doubted the NHS’s capacity to deliver an MCED screening programme and offer appropriate and timely results, follow-up, and treatment due to lack of staff and long waiting lists. Participants felt MCED screening would be futile if those with positive results were not followed up and treated quickly, before their cancer had time to “spread”.

“If it detected that you may have cancer, you’re gonna have anxiety for the next six months until the NHS decides that they’re gonna come and test you, or you can go for testing. And the anxiety would just be so bad. It’s just ridiculous, you know? And even if you did have it, you would then be waiting this year, next year, sometime never, for any treatment. So, I can’t see the point of it, I’m afraid.” [F, 70, G7]

There was acknowledgement that MCED screening could reduce future treatment burden but also concern that it could place extra pressure on already “hard-pressed” staff. In particular, GPs were not expected to cope with the introduction of MCED screening as they “have enough to deal with”.

Participants recognised that the NHS is “struggling financially” and that cost-effectiveness would likely influence how MCED screening might be implemented, including who would be eligible and the frequency of screening. Some expressed concerns that MCED screening might be implemented to the detriment of other services. Others felt MCED screening would be cost-effective since blood tests are relatively cheap and earlier detection of cancer can reduce future treatment costs.

“There might be a big cost at the beginning, in doing all this screening ... But there would be a long-term saving in the amount of people that are going into hospital, and ... seeing GPs.” [M, 75, G2]

Contrastingly, some felt MCED screening would not be cost-effective since it involves “testing an awful lot of people with nothing wrong”.

4. Discussion

Participants in our focus groups were generally positive about the potential introduction of population-based MCED screening. Enthusiasm for MCED screening was influenced by the procedural familiarity of blood tests and the potential to screen for many cancers at once. Feeling at increased risk of cancer also motivated interest in MCED screening which was considered a positive way to take control of their health and reduce uncertainty by detecting cancer early. Participants expressed concerns around the accuracy of MCED tests and their potential to cause anxiety at a range of points within the screening pathway. Others expressed hesitations around the need for unpleasant procedures or treatments if they received a positive screening result or if cancer was diagnosed following MCED screening.

Many participants expressed positive views on MCED screening after only a single sentence introducing the concept. Enthusiasm for MCED screening is consistent with existing evidence which suggests extremely positive attitudes towards cancer screening in general ([Waller et al., 2015](#); [Schwartz et al., 2004](#)). Some expressed hesitancy after additional

information, particularly around the potential need for further investigations and the possibility of a 'false positive' and 'a cancer that's been missed'. Concerns about anxiety following a false-positive screening result have been observed in other contexts (Dunlop et al., 2021). If MCEd screening is implemented, information materials will need to support informed decision-making (Stefanek, 2011; Marteau et al., 2001).

The more negative attitudes expressed by participants included the perception, also observed elsewhere, that screening is unnecessary for asymptomatic people (Young et al., 2018), as well as fatalistic views about the incurability of cancer (Miles et al., 2011). Participants who were less enthusiastic about MCEd screening, highlighted that they would be anxious in the face of positive results, were concerned about the need for unpleasant medical procedures and would not want to have cancer treatment if cancer was found. Similar themes have been raised in studies with participants who had decided not to participate in colorectal cancer screening (Hall et al., 2015; McCaffery et al., 2001) and research is underway investigating the effect of MCEd screening participation on psychological outcomes such as anxiety (Marlow et al., 2023). Understanding the views of those who are reluctant to be screened could also support the design of information materials.

Our findings suggest that the likelihood of having no cancer found after a positive MCEd test result may impact acceptability in the general population. Despite being relatively high for a cancer screening test, participants generally seemed critical of the 50% positive predictive value (PPV) that we presented. The view that 50% represents low accuracy suggests a disconnect between public attitudes and clinically acceptable accuracy within the screening context, and suggests a lack of awareness about the PPV in existing screening programmes (e.g. ~25%, calculated with data from the NHS Breast Screening Programme in 2021-22 (NHS Digital, 2021)). Similarly, 'unrealistic' expectations have been demonstrated in relation to breast cancer screening accuracy (Barratt et al., 1999), and these findings suggest initiatives to support awareness about the accuracy of screening tests in general could be beneficial in both improving understanding of existing screening tests and MCEd tests.

The importance participants placed on high accuracy is consistent with recent work exploring preferences for MCEd screening using a discrete choice experiment (Gelhorn et al., 2023). It is important to note that it was not always clear throughout the focus groups what participants meant by terms such as "accuracy", "efficiency" and "reliable". The aversion to ambiguity shown here aligns with other research where individuals made more aware of uncertainties in cancer screening showed decreased interest in screening (Wolf et al., 1996). If implemented, the accuracy of MCEd screening should be communicated early on. While this has the potential to reduce participation, it will help to ensure people who experience 'false positives' maintain trust in screening. Similarly, it will be important to effectively communicate that MCEd screening is not able to definitively rule out cancer to avoid false reassurance and ensure MCEd screening participants continue seek help in the face of symptoms. Transparency about accuracy may also be reassuring to those who receive a positive screening result, reducing anxiety if they know that cancer is not always found after investigations.

Further work is needed to establish effective communications around the accuracy of MCEd tests, taking account of pre-existing expectations. Since several participants expressed frustration that MCEds would not replace current screening, messaging might usefully emphasise that concurrent screening provides an extra opportunity to 'catch cancer'. This could be an effective strategy to alleviate accuracy concerns relating to MCEds, whilst also promoting the value of concurrent screening.

The pervasive discussion about the current NHS context indicates this will be an important consideration in the UK. It was evident that views and experiences within a particular healthcare context are likely to impact the acceptability of MCEd screening and views about the feasibility of implementation. Even though certain views expressed by

participants were directly related to the NHS context, some aspects such as trust in healthcare providers (as seen in other screening studies internationally (Dunlop et al., 2021)) and views on the feasibility of effective implementation are likely to apply in other contexts. The apparent importance of healthcare context, personal experiences and the experiences of others within this study suggest that a socio-ecological model (e.g. (Docum  t et al., 2008; Golden and Wendel, 2020; McLeroy et al., 1988; Unger-Salda  a et al., 2020)), could provide a useful framework for future research in this area.

Elements of the COM-B and TFA were evident in our findings. The COM-B (Michie et al., 2014) describes *automatic* and *reflective motivation*. Both were expressed by participants. Automatic motivation (i.e. the impulsive response to the test) was evident in many participants' immediate responses and positive gut feelings about MCEd screening. More *reflective motivation* was influenced by individual differences in views about cancer, personal risk, test accuracy and anxiety following screening. For many, *capability* for MCEd blood-test screening was high since it was considered quick and easy to have a blood test. *Opportunity* to take part was expected to be inhibited due to difficulties getting appointments within the NHS, but discussions around *opportunity* were limited by uncertainty about how screening might be offered. Many of the dimensions highlighted in the Theoretical Framework of Acceptability (Sekhon et al., 2017) also appeared relevant to public views on MCEd screening in this hypothetical context. This included *affective attitude* which was generally positive, *self-efficacy* which appeared high and *burden* which was expected to be low. The prospect of blood-based cancer screening had good *intervention coherence* and *ethicality* was also relevant, with some raising concerns about the appropriate use of NHS resources. Most thought MCEd screening would be an effective intervention but concerns about treatment and follow-up testing limited *perceived effectiveness* for some. *Opportunity costs* were the only component not discussed. The TFA was designed to support understanding of intervention acceptability across the course of its development and introduction; prospectively (as we have used it here), but also concurrently and retrospectively. Our findings suggest this could be a helpful framework for further research in the MCEd acceptability field alongside the COM-B which offers a broader framework to understand participation behaviour.

4.1. Strengths and limitations

We purposefully recruited men and women to represent a range of ethnic backgrounds. However, participants were all able to speak English, and almost all had lived in England for more than 10 years. Recent migrants and non-English speakers may have unique views on MCEd screening not captured in this study. The study benefited from the inclusion of individuals who would not want a blood test for cancer and most of these participants would not want cancer screening generally. This group's voices are seldom heard in screening research, yet their views represent important perspectives in light of informed decision-making.

The use of an opt-in internet-based panel means individuals with low digital literacy, or low confidence or motivation to participate in research may not have been adequately represented. Individuals in our sample were also typically highly educated and predominantly in the youngest age group (50-59). Further research is needed to assess how attitudes to MCEd screening might vary by demographic characteristics.

As MCEd blood tests have not yet demonstrated clinical utility as population screening tools, the discussions that took place were hypothetical in nature and it is possible that additional factors would come to the forefront in the face of an actual MCEd screening offer. The views expressed here highlight various aspects that will likely impact motivation to take part. The gap between intention and behaviour is more likely to be explained by capability and opportunity to participate. These are hard to determine without a person knowing exactly how a test will be offered and what their life circumstances will be when the offer

arrives. We recommend further work is done to explore actual screening behaviour if MCED population-based screening is implemented.

At the time of the study, GRAIL's Galleri test was at an advanced stage of development and trialling, with a randomised screening trial underway (Neal et al., 2022). As such, some of the information provided to participants was based on the Galleri test. Overall, we expect that the results of this study will be applicable to other blood-based MCEDs should they be available; however caution should be taken if test characteristics are significantly different to those described to our participants. The in-depth discussions in our focus groups encouraged participants to build a considered view of MCED screening based on the information provided. However, since we know many people do not fully engage with information materials before deciding whether to take part in cancer screening (Kobayashi et al., 2016), the results of this study may not be reflected in a real-life setting, where there is less opportunity to discuss views.

5. Conclusion

This is the first study to explore the acceptability of MCED blood test screening. MCED screening was considered an easy way to screen for many cancers at once and detect cancer early to improve outcomes. Nevertheless, participants raised a number of concerns about test accuracy, anxiety following a positive screening result, and unpleasant follow-up tests and treatments. Future research should seek to quantify the prevalence of these concerns. Supporting informed decision-making regarding participation in MCED screening will be vital.

CRediT authorship contribution statement

Ninian Schmeising-Barnes: Data curation, Formal analysis, Investigation, Project administration, Writing – original draft. **Jo Waller:** Conceptualization, Funding acquisition, Investigation, Supervision, Writing – review & editing. **Laura A.V. Marlow:** Conceptualization, Formal analysis, Investigation, Supervision, Writing – original draft, Writing – review & editing.

Declaration of competing interest

JW reports research income from GRAIL Bio UK, which funds 20% of her salary and the full salaries of LAVM and NSB through a contract with King's College London.

Data availability

The data that has been used is confidential.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.socscimed.2024.116762>.

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