



Treading carefully: an ethnography of the clinical, social and educational uses of exercise electrocardiograms in evaluating stable chest pain

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Treading carefully: an ethnography of the clinical, social and educational uses of exercise electrocardiograms in evaluating stable chest pain

Short running head: 'Uses of the exercise ECG in evaluating stable chest pain'

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ABSTRACT

Objective: To examine functions of the exercise electrocardiogram (ECG) in the light of the recent NICE guidelines recommending it should not be used for the diagnosis or exclusion of stable angina.

Design: Qualitative ethnographic study based on interviews and observations of clinical practice.

Setting: Three rapid access chest pain clinics in England.

Participants: Observation of 89 consultations in chest pain clinics, 18 patient interviews and 12 clinician interviews.

Main Outcome Measure: Accounts and observations of consultations in chest pain clinics.

Results: The exercise ECG was observed to have functions that extended beyond diagnosis. It was used to clarify a patient's story and revise the initial account. The act of walking on the treadmill created an additional opportunity for dialogue between clinician and patient and engagement of the patient in the diagnostic process through precipitation of symptoms and further elaboration of symptoms. The exercise ECG facilitated reassurance in relation to exercise capacity and tolerance, providing a platform for behavioural advice particularly when exercise was promoted by the clinician.

Conclusions: Many of the practices that have been built up around the use of the exercise ECG are potentially beneficial to patients and need to be considered in the re-design of services without that test. Through its contribution to the patient's history and to subsequent advice to the patient, the exercise ECG continues to inform the specialist assessment and management of patients with new onset stable chest pain, beyond its now marginalised role in diagnosis.

ARTICLE SUMMARY

Article Focus

- Given the widespread use of the exercise electrocardiogram (ECG) in assessments of patients with stable chest pain, this paper seeks to understand its role in the light of emerging evidence about its poor performance as a diagnostic test.
- This paper reports on the functions of the exercise ECG in UK chest pain clinics, highlighting those uses that go beyond its diagnostic function.
- This paper is part of an international debate about the appropriate initial tests for patients with new onset stable chest pain.

Key Messages

- The exercise ECG has additional functions that transcend its technical contribution to diagnosis: it can help clarify symptoms and other aspects of the clinical history, engage the patient in the diagnostic process, provide a context for guidance on reversible cardiovascular risk factors, be used to better involve and reassure patients and has the potential use for tailored lifestyle advice.
- Through its contribution to the patient's history and to subsequent advice to the patient, the exercise ECG continues to inform the specialist assessment and management of patients with new onset stable chest pain, beyond its now marginalised role in diagnosis.
- Many of the practices that have been built up around the use of the exercise ECG are potentially beneficial to patients. As chest pain clinic services are re-configured without the test, in line with UK national (NICE) guidance, these practices need to be integrated into new diagnostic pathways.

Strengths and limitations

- A strength of our study is its ethnographic design incorporating the observation of patient-clinician consultations and combining these data with interviews: we knew what participants did as well as said.
- The fieldwork was undertaken at a key time just before the introduction of the UK's 2010 National Institute for Health and Clinical Excellence (NICE) guidelines and therefore provides an understanding of current practice that can inform their implementation.

- A limitation of our study is that data were collected largely from two chest pain clinics, potentially limiting the transferability of the findings, although the clinicians in the research team thought that the clinics were not atypical compared to others had experienced.

INTRODUCTION

Internationally the exercise electrocardiogram (ECG) is the most common initial test for the evaluation of stable chest pain and has been used widely for almost half a century.[1] In the United Kingdom, exercise ECGs are a routinely performed, central part of patient assessment in most chest pain clinics, the main site of initial specialist referral.[2]

The 2010 UK National Institute for Health and Clinical Excellence (NICE) guidelines recommend that exercise ECGs should no longer be used to diagnose or exclude stable angina in patients.[3, 4] This recommendation is based on systematic reviews showing that other investigations have greater diagnostic accuracy [5, 6, 7, 8] and may be more cost effective at detecting people who are subsequently found to have coronary artery disease.[9] NICE recommends that the diagnosis of angina be based on clinical assessment alone or clinical assessment plus either anatomical imaging (e.g. coronary angiogram) or functional testing (e.g. stress echocardiography).

Medical technologies can have many functions beyond their explicit purpose.[10] Although technologies can distance the clinician from the patient, in some clinical settings they may facilitate a closer relationship.[11] Technologies, including diagnostic tests are not neutral; they embody specific cultural values and a range of implicit and explicit functions.[12,13,14] Ethnographic [15] and sociological [16] investigation of medical diagnosis reveals that this is a complex and often problematic process, in which the clinician combines results of diagnostic tests with the patient's narrative (structured as a clinical history), implicitly or explicitly forming, weighing up and testing hypotheses.[17] Clinical assessment and diagnosis takes place in specific settings in the context of a discursive and often physical relationship between clinician and patient. Guidance to clinicians needs to be informed by an understanding of this relationship and the clinical work of patient assessment, as well the diagnostic accuracy of symptoms, signs and tests.

OBJECTIVE

Given the widespread use of the exercise ECG in assessments of patients with stable chest pain, this paper seeks to understand its role in the light of emerging evidence about its poor performance as a diagnostic test. This paper reports on the functions of the exercise ECG in UK chest pain clinics, highlighting those uses that go beyond its diagnostic function.

METHODS

Participants, procedures and setting

This ethnographic study is part of a pilot for a randomised controlled trial of an intervention to improve chest pain diagnosis and management.[18] Participants were staff and patients in three English chest pain clinics: a provincial city centre hospital (A), a suburban city hospital (B), and a London hospital (C).

Observations

A total of 89 consultations were observed (by HC and ME) from July 2009 to June 2010. A sampling strategy of maximum variation was used to interview a range of clinicians (see table 1) about their current working practices, decision making processes and the role of different tests. A subset of patients were interviewed after the consultation to examine their experiences of the clinic, their understanding of the advice given and any behavioural changes they planned to make following their consultation.

Table 1: Summary of data collected

	Hospital A	Hospital B	Hospital C	Total
Participant observation				
Consultations observed	64	22	3	89
Meetings observed	6	3	0	9
Semi-structured interviews				

Staff				
Doctors	(3)	(1)	(3)	(7)
Cardiac nurses	(2)	(1)	(0)	(3)
Physiologists	(1)	(0)	(1)	(2)
Technicians	(2)	(0)	(1)	(3)
General practitioners				(3)
Patients	9	9	0	18

Half of the clinic consultations and interviews were audio-recorded and transcribed *verbatim*, half were recorded in detailed field notes. Data analysis was thematic, based on the constant comparative method [19] aided by the data management programme ATLAS ti.[20] HC and ME met regularly during the analysis to support consistency in coding, other members of the team (GF, KF and RJ) participated in further analysis. The analysis of the observational data was supplemented by and triangulated with data from staff and patient interviews.

RESULTS

In two of the three clinics (A and B) all patients who were able to do so performed an exercise ECG supervised by the clinician who took their initial history. In clinic C, exercise ECGs were only requested for selected patients and supervised by cardiac technicians.

Testing patient histories when wired up

Walking on the treadmill often stimulated symptoms that the patient had articulated in their initial account to the clinician and helped clarify the history (box 1, quote 1 and 2). The clinician asked further questions and the patient elaborated details, often enabling them to distinguish between different types of chest pain. In some cases the precipitation of symptoms such as palpitations on the treadmill supported the exclusion of angina (box 1 quote 3). Performance of exercise was also used to interrogate or contest other aspects of the history. For example a 62 year old man (P401, nurse S214 Hospital A) described himself as a 'frequent walker', however, he had difficulty walking on the treadmill even at the slowest pace and incline (see also box 1, quote 4).

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Box 1: Testing patient histories when wired up

1. Patient P404, doctor S117 observed in Hospital A.

A man in his 50s with five risk factors, described dizzy spells, and non-exertional pain in his chest, arm and shoulder. A short time after starting to walk on the treadmill this patient reported chest pain:

Patient: A little bit of chest pain.

Doctor: Like the one at home?

Patient: Similar.

Doctor: Just in the centre? Getting worse?

Patient: Yes.

After the treadmill had stopped the doctor asked some further questions:

Doctor: Giddy spells? Last 9 months?

Patient: I sit down and go white.

Doctor: Cold sweat?

Patient: Yes.

Doctor: That's important information.

In discussion afterwards the doctor said that an angiogram would not have been ordered without the additional symptoms and information gained from using the exercise ECG.

2. Nurse S232, Patient P123 observed in Hospital B:

Nurse: Well certainly talking to you before we even put you on the treadmill this all sounded very suggestive of the heart What this [exercise ECG] tells us is that there is a problem...and what we have seen today with this breathlessness and this tightness that you are getting, that the heart really isn't coping as it should be, so there are changes on the heart trace which [coughs] indicates something called ischemia.

3. Patient P102, nurse S214 observed in Hospital A.

A woman aged 54 referred with non-exertional discomfort in her upper left arm and palpitations.

Nurse: Well done [Beep] we've had your heart rate right up to about 170 there. How's it feeling now?

Patient: Erm ...

Nurse: Have you got that same sensation as you ...

Patient: Yeah.

Nurse: ... have experienced before?

Patient: Yeah, it's really not as ... this is worse, sort of thing.

Nurse: Right [Beep] well I can say very reassuringly that that's ... look at that, that's bog standard sinus tachycardia, which is absolutely what should happen when you exercise.

4. Doctor S117, Hospital A:

(T)he treadmill test is good [hmm...] it gives you a rough idea that the patient is telling the truth as well... So let us see how you do on the treadmill and then that gives us a good, good idea about his exercise ...sometimes they can't express as well, clearly... I mean they, they're not doctors so you ask them and they, they actually say I can't put, put a word as to how my pain is doctor. So, so it is difficult in that sort of situation you, you're not getting a good history [hmm...] but okay let's see what the treadmill test shows, that's what I think in my mind.... I think the treadmill test does give additional information.

Trust in exercise ECG as diagnostic aid

The language clinicians used when talking about the exercise ECG to patients was frequently that of evidence, certainty and diagnosis. For example “it could be angina and the treadmill test will quantify this” (nurse S214, P401 Hospital A) and “it looks normal, we got your heart rate up and no evidence that your heart is struggling” (nurse S232, P130 Hospital B). Trust in the diagnostic value of the exercise ECG is further reflected in the emphasis given to test results in discharge letters to GPs, for example “Results: This represents a positive exercise stress test. This result is diagnostic of CHD” (Hospital A). Generally, the exercise ECG was seen as a useful initial investigation: “as a first test you can’t beat that” (Doctor S117 Hospital A). Most clinicians also commented on limitations of the exercise ECG (box 2, quote 1). Nevertheless, despite universal acknowledgement of the history’s central role in diagnosis, clinicians expressed uncertainty and discomfort when the results of the exercise ECG contradicted rather than confirmed a patient’s history of typical angina (box 2, quote 2).

Box 2: Trust in exercise ECG as diagnostic aid

1.Nurse S215, Hospital A:

I think the decision is when you’re with a patient at first, and whether you put them, like I said, on a treadmill to exclude a coronary pathology, or to reassure the patient... But also ...there is research that suggests that it’s useless doing it because it’s not a very sensitive test.

2.Doctor S107, Hospital C:

It’s the history taking that makes you decide ... sort of history is ninety percent ... I decide whether or not it sounds like it’s angina ...and the only real difficulty is then if the exercise tolerance test is either negative, that’s the only difficulty when it’s negative. If it’s equivocal it’s not such a problem because then they’ll still go on to have an angiogram, or a thallium, or something.

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Patient involvement in the diagnostic process

In many cases the exercise ECG had an important role in reassuring patients when the clinicians thought they had excluded a diagnosis of angina (box 3, quote 1). In cases such as this, performance of the test facilitated immediate reassurance and reinforced the message to patients that the pains they were experiencing were not symptoms of an underlying heart problem and it was safe for them to exercise (box 3, quote 2 and 3). In patients given a diagnosis of angina, using the exercise ECG facilitated the explanation of the diagnosis. This was based on the experience of symptoms during the test and of the clinician’s response to the test output (box 3, quote 4).

The exercise ECG engaged patients directly in physical activity while being monitored by the clinician and via electrocardiography. This physical engagement of the patient through the expression and clarification of their symptoms, as well as their ability to watch the clinician’s expression whilst observing their performance precipitated further dialogue (box 3 quote 5) and informed the shape and content of reassurance at the end of the assessment.

Box 3: Patient involvement in the diagnostic process

1. Physiologist S213, Hospital A:

I think it’s being able to exercise in a controlled environment with somebody there who’s really going to push them a bit further than they would feel comfortable about doing outside and being able to take some recordings whether it’s for their ECG or their blood pressure in that controlled environment they know they’re safe ...yeah and then being able to tell them well you know you did really well there so don’t be afraid of doing that level of exercise outside and you know and it’s er everything was absolutely fine so it’s about confidence, it’s about allowing them to feel that those boundaries ...and maybe they could push themselves a little bit more.

2. Patient P402, nurse S214 observed in Hospital A.

At the beginning of the consultation this patient was in tears. After walking on the exercise ECG the nurse showed her a ‘perfect trace’ adding “you should be very proud! Do you want the good news or the good news? You did brilliantly and your ECG is normal.” The nurse then went on to discuss diet and exercise with the patient, encouraging her to walk more regularly and checking for anxieties that might stop her from doing this.

3. Patient P31, nurse S214 observed in Hospital A.

A woman was seen with a single episode of chest pain on exertion with no additional risk factors. After the history taking the nurse said “from what you described I’d be surprised if anything shows up.” The nurse stayed physically close by the patient during the exercise ECG and got her to engage in conversation. While still walking on the treadmill, after a routine blood pressure check the nurse said “that’s grand, text book and heart rate just beginning to increase. And gaining in confidence, a little cloud is lifting.” As this patient left the consultation with a non angina diagnosis she said “thank you, it’s peace of mind.”

4. Doctor S122, Patient P208 observed in Hospital A:

You did fairly well on the treadmill. The ECG didn’t show really much change. What we look for are symptoms and changes there, but the ECG part wasn’t bad. You had a little bit of tightness there so there might still be a little bit of a problem there, we need to find out. The best way to look at that is by an angiogram.

5. Doctor S117, Hospital A:

They feel it as well ...if they can’t run they are puffing and they see their heart rate and see [that they are] not doing much ...it is visual yes, yeah it is visual [mhm] they understand every bit of it. I mean nothing is hidden... And they, they see everything and heart rate going up and coming down. I think err it’s, it’s really more a patient centred that’s the best way to put it.... I mean they themselves can sort of interpret as well, ‘I didn’t do well [did I] doctor’?

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Facilitating behavioural advice

Performance of the exercise ECG gave the clinicians a context within which to recommend increase in exercise, change in diet and smoking cessation. Poor exercise performance was the basis of exercise and dietary advice in relation to weight loss. The exercise ECG performance was also used to reinforce healthy behaviours and the primary prevention of coronary artery disease (box 4, quotes 1, 2 and 3). Patients with a non cardiac diagnosis tended to receive exercise, diet and smoking advice whereas the focus with patients likely to have an angina diagnosis was on the next test.

As with diagnosis and reassurance, performing the exercise test opened up opportunities for discussion: “[I]t’s live and I can explain as it’s happening” (nurse S214, Hospital A). One clinician advised “currently heart rate going steadily shows a good base level fitness.....stop smoking” (nurse S214, P101 Hospital A) and “what I see: heart rate gone up quickly and shows she is unfit, so will need to talk about stamina training” (P337- comment made through an interpreter). Whilst the patients were on the treadmill, clinicians were also able to refer to their walking to demonstrate the intensity of exercise they should be doing (box 4, quote 4) and to reassure them that it was safe to exercise (box 4, quote 5).

The exercise ECG necessitates the removal of clothes on the top half of the body and performing exercise in front of the clinician seems to prompt specific advice on exercise and weight loss (box 4, quote 6). Several patients after walking on the exercise ECG remarked that the treadmill experience or symptoms induced during the test and the discussion with the clinician had been important for them (box 4, quote 7). The strangeness of the hospital environment may also mean that the exercise ECG had a potentially greater impact on a patient being receptive to hearing advice about behavioural changes (box 4, quote 8). However, while some patients remarked in interviews afterwards that they fully intended to make changes in diet and exercise, others clearly expressed that they had no intention to do that.

Not all clinicians used the performance of the exercise ECG to give educational advice. When interviewed, some clinicians said that they thought lifestyle advice was important, but did not offer it consistently in practice. Within clinic C, where the exercise ECG was not routinely performed with all patients (Hospital C) and was not supervised by the clinician who took the patient’s history, one clinician expressed frustration at the lack of opportunities to give lifestyle advice (box 4, quote 9).

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Box 4: Facilitating behavioural advice

1. Patient P340, nurses S215 and S214 observed in Hospital A.

After walking on the treadmill a nurse advised “can rule out not from heart, blood pressure outside the normal range. Carrying a bit more weight, know [you have]a knee problem, follow this up with GP. Don’t want to clock up risk factors...suggest do some weight loss, affects cholesterol and blood pressure. Alcohol? [patient nods] Suggest this is empty calories.”

2. Patient P338, nurse S214 observed in Hospital A.

A patient with a strong family history expressed concern that she ran a greater risk of developing heart disease. After walking on the treadmill she was told she did have a greater risk of developing heart disease but that she was doing the all right things to reduce the risk “keeping yourself slim and active and not smoking and not much alcohol.”

3. Doctor S117, Hospital A:

No I wouldn’t like to do without it [exercise ECG] because it really gives us many information not only about the ECG changes it tells us about heart rate response on exercise, blood pressure response on exercise and er exercise capacity in general, patient’s fitness... And that gives us a chance to tell about lifestyle modification....I mean that’s an important message to drive home to the patient.

4. Patient P402, nurse S214 observed in Hospital A:

Nurse: Normal walking pace?
Patient: Yes
Nurse:...brilliant well done. Is this like going to school in a hurry?
Patient: Yes
Nurse: Count this as exercise. You could do exercise like this, you need 30 minutes to do any good, need to get your heart rate up and keep it up.

5. Patient P418, nurse S214 observed in Hospital A:

Nurse: Like your normal speed? (Level I)
Patient: No it’s faster
Nurse: You’re walking too slow! Should be more like level II..... [And at the end of the consultation] Importance of regular walking, you can push yourself, it’s all safe. Do like level II or III, so you are a bit short of breath...There is no wrong thing about exercise. There is nothing sinister about your heart.

6. Patient P332, nurse S214 observed in Hospital A.

During the consultation the nurse initially said “I can tell by your shape you are overweight.” Later whilst walking the treadmill the nurse remarked “I can feel you are getting out of breath, how’s your chest?” When the patient replied that he has a pain in his back the nurse suggested that he pulled his stomach muscles in. At the end of the consultation, after a non angina diagnosis, the nurse said “you need to do more exercise and stop smoking.....no sign of angina. Let’s keep it that way.”

7. Patient P125, Hospital B.

During one post consultation interview a patient said that he understood the logic of the exercise ECG test in the sense that it could bring on chest pain “I cant think of any other way to generate the same problem.” He then said that in some ways would have liked to have experienced more pain during the exercise ECG so that he could have categorically said to the clinician “that’s what happened and that’s why I am here.”

Box 4 continued**8. Nurse S215, Hospital A:**

I think sometimes people when they come here, you see the difference that it's actually most times it hits home, and they think oh, this is quite frightening...Because it's a different environment. You know when you go to the GP it's a familiar environment, it's very much more kind of cosy, and don't get me wrong, I am not sort of dismissing the GP practice by any means, but I think when they come here, what I've seen so far, most people will listen to you carefully, because it kind of hits home...

9. Doctor S107, Hospital C:

that guy's a 40 year old, he shouldn't just be walking ten minutes to work and ten minutes back should he? I mean he should actually be exercising. ... You put them on a treadmill and they do four minutes and that's as ... the most they've walked ever...[it's] infuriating, because you can see that they've got risk ... if they stay the way they are, in ten years time they will be coming back with an MI....[but] with the clinic, you can't sit there and go through all their risk factors and stuff.

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DISCUSSION

We have shown that in patients with new onset stable chest pain the exercise ECG has a role in articulating the clinical history through stimulating symptoms such as chest pain and breathlessness, and prompting additional narrative details about their symptoms. For patients in whom angina is discounted, walking on the treadmill is used to reassure them that their symptoms are not cardiac in origin and that it is safe to exercise. Performing the exercise ECG gives patients an active physical role in the diagnostic process. During and after the exercise ECG a context is provided within which the clinician can give specific advice on exercise, weight loss, diet and smoking cessation. If clinicians use the full potential of the exercise ECG, they may also draw on the patients' experience of walking on the treadmill to demonstrate appropriate levels of exercise and the amount of breathlessness they should be experiencing to improve their fitness. These specific benefits arise from exercising in front of the clinician and are not a function of the additional time spent with the patient.

Through the exercise ECG both patients and clinicians have the opportunity to become engaged experientially, transcending the test's diagnostic function, particularly when the clinician is present and able to supervise the test. This engagement is not usually present in functional tests for coronary artery disease that have better diagnostic accuracy, such as radioisotope scanning, stress ultrasound, or MRI, because even when exercise is the stressor, the test is almost invariably removed in time and place from the clinic setting. Although some clinicians talked about the additional functions of the exercise ECG, many of these were implicit and emerged from our observations. Most of the clinicians we observed believed that the exercise ECG did contribute to their diagnostic decisions.[21] Most clinicians also recognised the prognostic value of the exercise ECG when asked directly in interview, but this was not reflected in our observations of their clinical practice.

In this ethnographic study of chest pain clinics we have shown that the exercise ECG was being used for a range of clinical, psychosocial and educational purposes that potentially benefit patients. These benefits would be lost if the wider functions of the exercise ECG were not implemented through other means once the exercise ECG is phased out of the assessment of patients with new onset stable chest pain in line with the UK NICE chest pain guidelines. However, loss of its wider functions is not inevitable if a way is found to integrate the exercise stress used in more contemporary functional tests with the evaluation of the patient in the chest pain clinic.

Either with clinical assessment alone or assessment using other diagnostic technologies patients may find themselves in a passive and physically static role in the absence of a supervising clinician. There will, for example, be no opportunities for patients to walk briskly on a treadmill stimulating symptoms and no opportunities for patients to use their experiences when walking to engage in a dialogue of questions and clarification. This will weaken the embodied [22, 23] and performance aspect of chest pain diagnosis [24] that goes beyond verbal exchanges.[16] The communication of pain is often difficult,[25] and complicated by differences in gender [26] and ethnicity. Communicating chest pain is associated with additional anxieties.[27,28] As other studies have shown, [29] successful reassurance hinges on clinicians being able to indicate that they have understood a patient's current situation and can communicate this in the consultation. Our study suggests that through physical engagement the exercise ECG can facilitate communication between patient and clinician which, even if not improving diagnostic accuracy, does enhance subsequent reassurance.

Another important feature of exercise testing in two of the clinics we observed was the presence of the clinician making the assessment, often a senior nurse practitioner or staff grade cardiologist. This is not generally the case with other functional tests for angina which are conducted by a technician in a different space from the clinical assessment by a clinician. The splitting of a diagnostic test from the wider clinical assessment may affect the potential depth of the relationship [30] and the potential to clarify the clinical history through engagement with the test, particularly if this involves exercise.

Strengths and limitations of the study

A strength of our study is its ethnographic design incorporating the observation of patient-clinician consultations and combining these data with interviews: we knew what participants did as well as said. The

fieldwork was undertaken at a key time just before the introduction of the NICE guidelines and therefore provides an understanding of current practice that can inform their implementation. A further strength is the combination of multiple perspectives from the wider research team of cardiologists, social scientists, health service researchers and epidemiologists. A limitation of our study is that data were collected largely from two chest pain clinics, potentially limiting the transferability of the findings, although the clinicians in the research team thought that the clinics were not atypical compared to others had experienced. Another limitation, due to time restrictions in the clinics, is that it was rarely possible for clinicians to talk through their decision making for each patient, which would have deepened our understanding of the role of the exercise ECG in this process.

CONCLUSIONS

As governments and professional bodies revise guidelines, the exercise ECG will have a diminishing role in the diagnosis of angina. However, many of the practices that have been built up around the use of the exercise ECG are potentially beneficial to patients and need to be considered in the re-design of chest pain assessment services without that test. In particular, the supervised exercising of patients, even if this does not explicitly inform diagnostic decisions or prognostic judgements, should form part of the assessment process.

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Contributors: GF, HH and AT designed the programme of research in which this study is embedded. GF and KF had the idea for the qualitative component of the study. HC and ME undertook the interviews, observations, analysed and interpreted the data, which was discussed with KF and GF. HC wrote the first draft. GF, KF, HH, MJZ, AT and RJ revised the article for important intellectual content. All members of the team gave final approval of the version published. GF and HC are the guarantors. All contributors had full access to all of the data in the study and can take responsibility for the integrity of the data and the accuracy of the data analysis.

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Treading carefully: an ethnography of the clinical, social and educational uses of exercise electrocardiograms in evaluating stable chest pain

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Treading carefully: an ethnography of the clinical, social and educational uses of exercise electrocardiograms in evaluating stable chest pain

Short running head: 'Uses of the exercise ECG in evaluating stable chest pain'

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ABSTRACT

Objective: To examine functions of the exercise electrocardiogram (ECG) in the light of the recent NICE guidelines recommending it should not be used for the diagnosis or exclusion of stable angina.

Design: Qualitative ethnographic study based on interviews and observations of clinical practice.

Setting: Three rapid access chest pain clinics in England.

Participants: Observation of 89 consultations in chest pain clinics, 18 patient interviews and 12 clinician interviews.

Main Outcome Measure: Accounts and observations of consultations in chest pain clinics.

Results: The exercise ECG was observed to have functions that extended beyond diagnosis. It was used to clarify a patient's story and revise the initial account. The act of walking on the treadmill created an additional opportunity for dialogue between clinician and patient and engagement of the patient in the diagnostic process through precipitation of symptoms and further elaboration of symptoms. The exercise ECG facilitated reassurance in relation to exercise capacity and tolerance, providing a platform for behavioural advice particularly when exercise was promoted by the clinician.

Conclusions: Many of the practices that have been built up around the use of the exercise ECG are potentially beneficial to patients and need to be considered in the re-design of services without that test. Through its contribution to the patient's history and to subsequent advice to the patient, the exercise ECG continues to inform the specialist assessment and management of patients with new onset stable chest pain, beyond its now marginalised role in diagnosis.

ARTICLE SUMMARY

Article Focus

- Given the widespread use of the exercise electrocardiogram (ECG) in assessments of patients with stable chest pain, this paper seeks to understand its role in the light of emerging evidence about its poor performance as a diagnostic test.
- This paper reports on the functions of the exercise ECG in UK chest pain clinics, highlighting those uses that go beyond its diagnostic function.
- This paper is part of an international debate about the appropriate initial tests for patients with new onset stable chest pain.

Key Messages

- The exercise ECG has additional functions that transcend its technical contribution to diagnosis: it can help clarify symptoms and other aspects of the clinical history, engage the patient in the diagnostic process, provide a context for guidance on reversible cardiovascular risk factors, be used to better involve and reassure patients and has the potential use for tailored lifestyle advice.
- Through its contribution to the patient's history and to subsequent advice to the patient, the exercise ECG continues to inform the specialist assessment and management of patients with new onset stable chest pain, beyond its now marginalised role in diagnosis.
- Many of the practices that have been built up around the use of the exercise ECG are potentially beneficial to patients. As chest pain clinic services are re-configured without the test, in line with UK national (NICE) guidance, these practices need to be integrated into new diagnostic pathways.

Strengths and limitations

- A strength of our study is its ethnographic design incorporating the observation of patient-clinician consultations and combining these data with interviews: we knew what participants did as well as said.
- The fieldwork was undertaken at a key time just before the introduction of the UK's 2010 National Institute for Health and Clinical Excellence (NICE) guidelines and therefore provides an understanding of current practice that can inform their implementation.

- A limitation of our study is that data were collected largely from two chest pain clinics, potentially limiting the transferability of the findings, although the clinicians in the research team thought that the clinics were not atypical compared to others had experienced.

INTRODUCTION

Internationally the exercise electrocardiogram (ECG) is the most common initial test for the evaluation of stable chest pain and has been used widely for almost half a century.[1] In the United Kingdom, exercise ECGs are a routinely performed, central part of patient assessment in most chest pain clinics, the main site of initial specialist referral.[2]

The 2010 UK National Institute for Health and Clinical Excellence (NICE) guidelines recommend that exercise ECGs should no longer be used to diagnose or exclude stable angina in patients.[3, 4] This recommendation is based on systematic reviews showing that other investigations have greater diagnostic accuracy [5, 6, 7, 8] and may be more cost effective at detecting people who are subsequently found to have coronary artery disease.[9] NICE recommends that the diagnosis of angina be based on clinical assessment alone or clinical assessment plus either anatomical imaging (e.g. coronary angiogram) or functional testing (e.g. stress echocardiography).

Medical technologies can have many functions beyond their explicit purpose.[10] Although technologies can distance the clinician from the patient, in some clinical settings they may facilitate a closer relationship.[11] Technologies, including diagnostic tests are not neutral; they embody specific cultural values and a range of implicit and explicit functions.[12,13,14] Ethnographic [15] and sociological [16] investigation of medical diagnosis reveals that this is a complex and often problematic process, in which the clinician combines results of diagnostic tests with the patient’s narrative (structured as a clinical history), implicitly or explicitly forming, weighing up and testing hypotheses.[17] Clinical assessment and diagnosis takes place in specific settings in the context of a discursive and often physical relationship between clinician and patient. Guidance to clinicians needs to be informed by an understanding of this relationship and the clinical work of patient assessment, as well the diagnostic accuracy of symptoms, signs and tests.

OBJECTIVE

Given the widespread use of the exercise ECG in assessments of patients with stable chest pain, this paper seeks to understand its role in the light of emerging evidence about its poor performance as a diagnostic test. This paper reports on the functions of the exercise ECG in UK chest pain clinics, highlighting those uses that go beyond its diagnostic function.

METHODS

Participants, procedures and setting

This ethnographic study is part of a pilot for a randomised controlled trial of an intervention to improve chest pain diagnosis and management.[18] Participants were staff and patients in three English chest pain clinics: a provincial city centre hospital (A), a suburban city hospital (B), and a London hospital (C).

Observations

A total of 89 consultations were observed (by HC and ME) from July 2009 to June 2010. A sampling strategy of maximum variation was used to interview a range of clinicians (see table 1) about their current working practices, decision making processes and the role of different tests. A subset of patients were interviewed after the consultation to examine their experiences of the clinic, their understanding of the advice given and any behavioural changes they planned to make following their consultation.

Table 1: Summary of data collected

	Hospital A	Hospital B	Hospital C	Total
Participant observation				
Consultations observed	64	22	3	89
Meetings observed	6	3	0	9
Semi-structured interviews				

Staff				
Doctors	(3)	(1)	(3)	(7)
Cardiac nurses	(2)	(1)	(0)	(3)
Physiologists	(1)	(0)	(1)	(2)
Technicians	(2)	(0)	(1)	(3)
General practitioners				(3)
Patients	9	9	0	18

Half of the clinic consultations and interviews were audio-recorded and transcribed *verbatim*, half were recorded in detailed field notes. Data analysis was thematic, based on the constant comparative method [19] aided by the data management programme ATLAS ti.[20] HC and ME met regularly during the analysis to support consistency in coding, other members of the team (GF, KF and RJ) participated in further analysis. The analysis of the observational data was supplemented by and triangulated with data from staff and patient interviews.

RESULTS

In two of the three clinics (A and B) all patients who were able to do so performed an exercise ECG supervised by the clinician who took their initial history. In clinic C, exercise ECGs were only requested for selected patients and supervised by cardiac technicians.

Testing patient histories when wired up

Walking on the treadmill often stimulated symptoms that the patient had articulated in their initial account to the clinician and helped clarify the history (box 1, quote 1 and 2). The clinician asked further questions and the patient elaborated details, often enabling them to distinguish between different types of chest pain. In some cases the precipitation of symptoms such as palpitations on the treadmill supported the exclusion of angina (box 1 quote 3). Performance of exercise was also used to interrogate or contest other aspects of the history. For example a 62 year old man (P401, nurse S214 Hospital A) described himself as a 'frequent walker', however, he had difficulty walking on the treadmill even at the slowest pace and incline (see also box 1, quote 4).

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Box 1: Testing patient histories when wired up

1. Patient P404, doctor S117 observed in Hospital A.

A man in his 50s with five risk factors, described dizzy spells, and non-exertional pain in his chest, arm and shoulder. A short time after starting to walk on the treadmill this patient reported chest pain:

Patient: A little bit of chest pain.

Doctor: Like the one at home?

Patient: Similar.

Doctor: Just in the centre? Getting worse?

Patient: Yes.

After the treadmill had stopped the doctor asked some further questions:

Doctor: Giddy spells? Last 9 months?

Patient: I sit down and go white.

Doctor: Cold sweat?

Patient: Yes.

Doctor: That's important information.

In discussion afterwards the doctor said that an angiogram would not have been ordered without the additional symptoms and information gained from using the exercise ECG.

2. Nurse S232, Patient P123 observed in Hospital B:

Nurse: Well certainly talking to you before we even put you on the treadmill this all sounded very suggestive of the heart What this [exercise ECG] tells us is that there is a problem...and what we have seen today with this breathlessness and this tightness that you are getting, that the heart really isn't coping as it should be, so there are changes on the heart trace which [coughs] indicates something called ischemia.

3. Patient P102, nurse S214 observed in Hospital A.

A woman aged 54 referred with non-exertional discomfort in her upper left arm and palpitations.

Nurse: Well done [Beep] we've had your heart rate right up to about 170 there. How's it feeling now?

Patient: Erm ...

Nurse: Have you got that same sensation as you ...

Patient: Yeah.

Nurse: ... have experienced before?

Patient: Yeah, it's really not as ... this is worse, sort of thing.

Nurse: Right [Beep] well I can say very reassuringly that that's ... look at that, that's bog standard sinus tachycardia, which is absolutely what should happen when you exercise.

4. Doctor S117, Hospital A:

(T)he treadmill test is good [hmm...] it gives you a rough idea that the patient is telling the truth as well... So let us see how you do on the treadmill and then that gives us a good, good idea about his exercise ...sometimes they can't express as well, clearly... I mean they, they're not doctors so you ask them and they, they actually say I can't put, put a word as to how my pain is doctor. So, so it is difficult in that sort of situation you, you're not getting a good history [hmm...] but okay let's see what the treadmill test shows, that's what I think in my mind.... I think the treadmill test does give additional information.

Trust in exercise ECG as diagnostic aid

The language clinicians used when talking about the exercise ECG to patients was frequently that of evidence, certainty and diagnosis. For example “it could be angina and the treadmill test will quantify this” (nurse S214, P401 Hospital A) and “it looks normal, we got your heart rate up and no evidence that your heart is struggling” (nurse S232, P130 Hospital B). Trust in the diagnostic value of the exercise ECG is further reflected in the emphasis given to test results in discharge letters to GPs, for example “Results: This represents a positive exercise stress test. This result is diagnostic of CHD” (Hospital A). Generally, the exercise ECG was seen as a useful initial investigation: “as a first test you can’t beat that” (Doctor S117 Hospital A). Most clinicians also commented on limitations of the exercise ECG (box 2, quote 1). Nevertheless, despite universal acknowledgement of the history’s central role in diagnosis, clinicians expressed uncertainty and discomfort when the results of the exercise ECG contradicted rather than confirmed a patient’s history of typical angina (box 2, quote 2).

Box 2: Trust in exercise ECG as diagnostic aid

1.Nurse S215, Hospital A:

I think the decision is when you’re with a patient at first, and whether you put them, like I said, on a treadmill to exclude a coronary pathology, or to reassure the patient... But also ...there is research that suggests that it’s useless doing it because it’s not a very sensitive test.

2.Doctor S107, Hospital C:

It’s the history taking that makes you decide ... sort of history is ninety percent ... I decide whether or not it sounds like it’s angina ...and the only real difficulty is then if the exercise tolerance test is either negative, that’s the only difficulty when it’s negative. If it’s equivocal it’s not such a problem because then they’ll still go on to have an angiogram, or a thallium, or something.

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Patient involvement in the diagnostic process

In many cases the exercise ECG had an important role in reassuring patients when the clinicians thought they had excluded a diagnosis of angina (box 3, quote 1). In cases such as this, performance of the test facilitated immediate reassurance and reinforced the message to patients that the pains they were experiencing were not symptoms of an underlying heart problem and it was safe for them to exercise (box 3, quote 2 and 3). In patients given a diagnosis of angina, using the exercise ECG facilitated the explanation of the diagnosis. This was based on the experience of symptoms during the test and of the clinician’s response to the test output (box 3, quote 4).

The exercise ECG engaged patients directly in physical activity while being monitored by the clinician and via electrocardiography. This physical engagement of the patient through the expression and clarification of their symptoms, as well as their ability to watch the clinician’s expression whilst observing their performance precipitated further dialogue (box 3 quote 5) and informed the shape and content of reassurance at the end of the assessment.

Box 3: Patient involvement in the diagnostic process

1. Physiologist S213, Hospital A:

I think it’s being able to exercise in a controlled environment with somebody there who’s really going to push them a bit further than they would feel comfortable about doing outside and being able to take some recordings whether it’s for their ECG or their blood pressure in that controlled environment they know they’re safe ...yeah and then being able to tell them well you know you did really well there so don’t be afraid of doing that level of exercise outside and you know and it’s er everything was absolutely fine so it’s about confidence, it’s about allowing them to feel that those boundaries ...and maybe they could push themselves a little bit more.

2. Patient P402, nurse S214 observed in Hospital A.

At the beginning of the consultation this patient was in tears. After walking on the exercise ECG the nurse showed her a ‘perfect trace’ adding “you should be very proud! Do you want the good news or the good news? You did brilliantly and your ECG is normal.” The nurse then went on to discuss diet and exercise with the patient, encouraging her to walk more regularly and checking for anxieties that might stop her from doing this.

3. Patient P31, nurse S214 observed in Hospital A.

A woman was seen with a single episode of chest pain on exertion with no additional risk factors. After the history taking the nurse said “from what you described I’d be surprised if anything shows up.” The nurse stayed physically close by the patient during the exercise ECG and got her to engage in conversation. While still walking on the treadmill, after a routine blood pressure check the nurse said “that’s grand, text book and heart rate just beginning to increase. And gaining in confidence, a little cloud is lifting.” As this patient left the consultation with a non angina diagnosis she said “thank you, it’s peace of mind.”

4. Doctor S122, Patient P208 observed in Hospital A:

You did fairly well on the treadmill. The ECG didn’t show really much change. What we look for are symptoms and changes there, but the ECG part wasn’t bad. You had a little bit of tightness there so there might still be a little bit of a problem there, we need to find out. The best way to look at that is by an angiogram.

5. Doctor S117, Hospital A:

They feel it as well ...if they can’t run they are puffing and they see their heart rate and see [that they are] not doing much ...it is visual yes, yeah it is visual [mhm] they understand every bit of it. I mean nothing is hidden... And they, they see everything and heart rate going up and coming down. I think err it’s, it’s really more a patient centred that’s the best way to put it.... I mean they themselves can sort of interpret as well, ‘I didn’t do well [did I] doctor’?

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Facilitating behavioural advice

Performance of the exercise ECG gave the clinicians a context within which to recommend increase in exercise, change in diet and smoking cessation. Poor exercise performance was the basis of exercise and dietary advice in relation to weight loss. The exercise ECG performance was also used to reinforce healthy behaviours and the primary prevention of coronary artery disease (box 4, quotes 1, 2 and 3). Patients with a non cardiac diagnosis tended to receive exercise, diet and smoking advice whereas the focus with patients likely to have an angina diagnosis was on the next test.

As with diagnosis and reassurance, performing the exercise test opened up opportunities for discussion: “[I]t’s live and I can explain as it’s happening” (nurse S214, Hospital A). One clinician advised “currently heart rate going steadily shows a good base level fitness.....stop smoking” (nurse S214, P101 Hospital A) and “what I see: heart rate gone up quickly and shows she is unfit, so will need to talk about stamina training” (P337- comment made through an interpreter). Whilst the patients were on the treadmill, clinicians were also able to refer to their walking to demonstrate the intensity of exercise they should be doing (box 4, quote 4) and to reassure them that it was safe to exercise (box 4, quote 5).

The exercise ECG necessitates the removal of clothes on the top half of the body and performing exercise in front of the clinician seems to prompt specific advice on exercise and weight loss (box 4, quote 6). Several patients after walking on the exercise ECG remarked that the treadmill experience or symptoms induced during the test and the discussion with the clinician had been important for them (box 4, quote 7). The strangeness of the hospital environment may also mean that the exercise ECG had a potentially greater impact on a patient being receptive to hearing advice about behavioural changes (box 4, quote 8). However, while some patients remarked in interviews afterwards that they fully intended to make changes in diet and exercise, others clearly expressed that they had no intention to do that.

Not all clinicians used the performance of the exercise ECG to give educational advice. When interviewed, some clinicians said that they thought lifestyle advice was important, but did not offer it consistently in practice. Within clinic C, where the exercise ECG was not routinely performed with all patients (Hospital C) and was not supervised by the clinician who took the patient’s history, one clinician expressed frustration at the lack of opportunities to give lifestyle advice (box 4, quote 9).

Box 4: Facilitating behavioural advice

1. Patient P340, nurses S215 and S214 observed in Hospital A.

After walking on the treadmill a nurse advised “can rule out not from heart, blood pressure outside the normal range. Carrying a bit more weight, know [you have] a knee problem, follow this up with GP. Don’t want to clock up risk factors...suggest do some weight loss, affects cholesterol and blood pressure. Alcohol? [patient nods] Suggest this is empty calories.”

2. Patient P338, nurse S214 observed in Hospital A.

A patient with a strong family history expressed concern that she ran a greater risk of developing heart disease. After walking on the treadmill she was told she did have a greater risk of developing heart disease but that she was doing the all right things to reduce the risk “keeping yourself slim and active and not smoking and not much alcohol.”

3. Doctor S117, Hospital A:

No I wouldn’t like to do without it [exercise ECG] because it really gives us many information not only about the ECG changes it tells us about heart rate response on exercise, blood pressure response on exercise and er exercise capacity in general, patient’s fitness... And that gives us a chance to tell about lifestyle modification....I mean that’s an important message to drive home to the patient.

4. Patient P402, nurse S214 observed in Hospital A:

Nurse: Normal walking pace?
Patient: Yes
Nurse:...brilliant well done. Is this like going to school in a hurry?
Patient: Yes
Nurse: Count this as exercise. You could do exercise like this, you need 30 minutes to do any good, need to get your heart rate up and keep it up.

5. Patient P418, nurse S214 observed in Hospital A:

Nurse: Like your normal speed? (Level I)
Patient: No it’s faster
Nurse: You’re walking too slow! Should be more like level II..... [And at the end of the consultation] Importance of regular walking, you can push yourself, it’s all safe. Do like level II or III, so you are a bit short of breath...There is no wrong thing about exercise. There is nothing sinister about your heart.

6. Patient P332, nurse S214 observed in Hospital A.

During the consultation the nurse initially said “I can tell by your shape you are overweight.” Later whilst walking the treadmill the nurse remarked “I can feel you are getting out of breath, how’s your chest?” When the patient replied that he has a pain in his back the nurse suggested that he pulled his stomach muscles in. At the end of the consultation, after a non angina diagnosis, the nurse said “you need to do more exercise and stop smoking.....no sign of angina. Let’s keep it that way.”

7. Patient P125, Hospital B.

During one post consultation interview a patient said that he understood the logic of the exercise ECG test in the sense that it could bring on chest pain “I cant think of any other way to generate the same problem.” He then said that in some ways would have liked to have experienced more pain during the exercise ECG so that he could have categorically said to the clinician “that’s what happened and that’s why I am here.”

Box 4 continued**8. Nurse S215, Hospital A:**

I think sometimes people when they come here, you see the difference that it's actually most times it hits home, and they think oh, this is quite frightening...Because it's a different environment. You know when you go to the GP it's a familiar environment, it's very much more kind of cosy, and don't get me wrong, I am not sort of dismissing the GP practice by any means, but I think when they come here, what I've seen so far, most people will listen to you carefully, because it kind of hits home...

9. Doctor S107, Hospital C:

that guy's a 40 year old, he shouldn't just be walking ten minutes to work and ten minutes back should he? I mean he should actually be exercising. ... You put them on a treadmill and they do four minutes and that's as ... the most they've walked ever...[it's] infuriating, because you can see that they've got risk ... if they stay the way they are, in ten years time they will be coming back with an MI....[but] with the clinic, you can't sit there and go through all their risk factors and stuff.

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DISCUSSION

We have shown that in patients with new onset stable chest pain the exercise ECG has a role in articulating the clinical history through stimulating symptoms such as chest pain and breathlessness, and prompting additional narrative details about their symptoms. For patients in whom angina is discounted, walking on the treadmill is used to reassure them that their symptoms are not cardiac in origin and that it is safe to exercise. Performing the exercise ECG gives patients an active physical role in the diagnostic process. During and after the exercise ECG a context is provided within which the clinician can give specific advice on exercise, weight loss, diet and smoking cessation. If clinicians use the full potential of the exercise ECG, they may also draw on the patients' experience of walking on the treadmill to demonstrate appropriate levels of exercise and the amount of breathlessness they should be experiencing to improve their fitness. These specific benefits arise from exercising in front of the clinician and are not a function of the additional time spent with the patient.

Through the exercise ECG both patients and clinicians have the opportunity to become engaged experientially, transcending the test's diagnostic function, particularly when the clinician is present and able to supervise the test. This engagement is not usually present in functional tests for coronary artery disease that have better diagnostic accuracy, such as radioisotope scanning, stress ultrasound, or MRI, because even when exercise is the stressor, the test is almost invariably removed in time and place from the clinic setting. Although some clinicians talked about the additional functions of the exercise ECG, many of these were implicit and emerged from our observations. Most of the clinicians we observed believed that the exercise ECG did contribute to their diagnostic decisions.[21] Most clinicians also recognised the prognostic value of the exercise ECG when asked directly in interview, but this was not reflected in our observations of their clinical practice.

In this ethnographic study of chest pain clinics we have shown that the exercise ECG was being used for a range of clinical, psychosocial and educational purposes that potentially benefit patients. These benefits would be lost if the wider functions of the exercise ECG were not implemented through other means once the exercise ECG is phased out of the assessment of patients with new onset stable chest pain in line with the UK NICE chest pain guidelines. However, loss of its wider functions is not inevitable if a way is found to integrate the exercise stress used in more contemporary functional tests with the evaluation of the patient in the chest pain clinic.

Either with clinical assessment alone or assessment using other diagnostic technologies patients may find themselves in a passive and physically static role in the absence of a supervising clinician. There will, for example, be no opportunities for patients to walk briskly on a treadmill stimulating symptoms and no opportunities for patients to use their experiences when walking to engage in a dialogue of questions and clarification. This will weaken the embodied [22, 23] and performance aspect of chest pain diagnosis [24] that goes beyond verbal exchanges.[16] The communication of pain is often difficult,[25] and complicated by differences in gender [26] and ethnicity. Communicating chest pain is associated with additional anxieties.[27,28] As other studies have shown, [29] successful reassurance hinges on clinicians being able to indicate that they have understood a patient's current situation and can communicate this in the consultation. Our study suggests that through physical engagement the exercise ECG can facilitate communication between patient and clinician which, even if not improving diagnostic accuracy, does enhance subsequent reassurance.

Another important feature of exercise testing in two of the clinics we observed was the presence of the clinician making the assessment, often a senior nurse practitioner or staff grade cardiologist. This is not generally the case with other functional tests for angina which are conducted by a technician in a different space from the clinical assessment by a clinician. The splitting of a diagnostic test from the wider clinical assessment may affect the potential depth of the relationship [30] and the potential to clarify the clinical history through engagement with the test, particularly if this involves exercise.

Strengths and limitations of the study

A strength of our study is its ethnographic design incorporating the observation of patient-clinician consultations and combining these data with interviews: we knew what participants did as well as said. The

fieldwork was undertaken at a key time just before the introduction of the NICE guidelines and therefore provides an understanding of current practice that can inform their implementation. A further strength is the combination of multiple perspectives from the wider research team of cardiologists, social scientists, health service researchers and epidemiologists. A limitation of our study is that data were collected largely from two chest pain clinics, potentially limiting the transferability of the findings, although the clinicians in the research team thought that the clinics were not atypical compared to others had experienced. Another limitation, due to time restrictions in the clinics, is that it was rarely possible for clinicians to talk through their decision making for each patient, which would have deepened our understanding of the role of the exercise ECG in this process.

CONCLUSIONS

As governments and professional bodies revise guidelines, the exercise ECG will have a diminishing role in the diagnosis of angina. However, many of the practices that have been built up around the use of the exercise ECG are potentially beneficial to patients and need to be considered in the re-design of chest pain assessment services without that test. In particular, the supervised exercising of patients, even if this does not explicitly inform diagnostic decisions or prognostic judgements, should form part of the assessment process.

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Ethical approval: The study was approved by the West London NHS multicentre research ethics committee (08/H0709/85)

Contributors: GF, HH and AT designed the programme of research in which this study is embedded. GF and KF had the idea for the qualitative component of the study. HC and ME undertook the interviews, observations, analysed and interpreted the data, which was discussed with KF and GF. HC wrote the first draft. GF, KF, HH, MJZ, AT and RJ revised the article for important intellectual content. All members of the team gave final approval of the version published. GF and HC are the guarantors. All contributors had full access to all of the data in the study and can take responsibility for the integrity of the data and the accuracy of the data analysis.

Data sharing: There is no additional data available.

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Treading carefully: a qualitative ethnographic study of the clinical, social and educational uses of exercise electrocardiograms in evaluating stable chest pain

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Treading carefully: a qualitative ethnographic study of the clinical, social and educational uses of exercise electrocardiograms in evaluating stable chest pain

Short running head: 'Uses of the exercise ECG in evaluating stable chest pain'

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ABSTRACT

Objective: To examine functions of the exercise electrocardiogram (ECG) in the light of the recent NICE guidelines recommending it should not be used for the diagnosis or exclusion of stable angina.

Design: Qualitative ethnographic study based on interviews and observations of clinical practice.

Setting: Three rapid access chest pain clinics in England.

Participants: Observation of 89 consultations in chest pain clinics, 18 patient interviews and 12 clinician interviews.

Main Outcome Measure: Accounts and observations of consultations in chest pain clinics.

Results: The exercise ECG was observed to have functions that extended beyond diagnosis. It was used to clarify a patient's story and revise the initial account. The act of walking on the treadmill created an additional opportunity for dialogue between clinician and patient and engagement of the patient in the diagnostic process through precipitation of symptoms and further elaboration of symptoms. The exercise ECG facilitated reassurance in relation to exercise capacity and tolerance, providing a platform for behavioural advice particularly when exercise was promoted by the clinician.

Conclusions: Many of the practices that have been built up around the use of the exercise ECG are potentially beneficial to patients and need to be considered in the re-design of services without that test. Through its contribution to the patient's history and to subsequent advice to the patient, the exercise ECG continues to inform the specialist assessment and management of patients with new onset stable chest pain, beyond its now marginalised role in diagnosis.

ARTICLE SUMMARY

Article focus

- Given the widespread use of the exercise electrocardiogram (ECG) in assessments of patients with stable chest pain, this paper seeks to understand its role in the light of emerging evidence about its poor performance as a diagnostic test.
- This paper reports on the functions of the exercise ECG in UK chest pain clinics, highlighting those uses that go beyond its diagnostic function.
- This paper is part of an international debate about the appropriate initial tests for patients with new onset stable chest pain.

Key messages

- The exercise ECG has additional functions that transcend its technical contribution to diagnosis: it can help clarify symptoms and other aspects of the clinical history, engage the patient in the diagnostic process, provide a context for guidance on reversible cardiovascular risk factors, be used to better involve and reassure patients and has the potential use for tailored lifestyle advice.
- Through its contribution to the patient's history and to subsequent advice to the patient, the exercise ECG continues to inform the specialist assessment and management of patients with new onset stable chest pain, beyond its now marginalised role in diagnosis.
- Many of the practices that have been built up around the use of the exercise ECG are potentially beneficial to patients. As chest pain clinic services are re-configured without the test, in line with UK national (NICE) guidance, these practices need to be integrated into new diagnostic pathways.

Strengths and limitations

- A strength of our study is its ethnographic design incorporating the observation of patient-clinician consultations and combining these data with interviews: we knew what participants did as well as said.
- The fieldwork was undertaken at a key time just before the introduction of the UK's 2010 National Institute for Health and Clinical Excellence (NICE) guidelines and therefore provides an understanding of current practice that can inform their implementation.
- A limitation of our study is that data were collected largely from two chest pain clinics, potentially limiting the transferability of the findings, although the clinicians in the research team thought that the clinics were not atypical compared to others had experienced.

INTRODUCTION

Internationally the exercise electrocardiogram (ECG) is the most common initial test for the evaluation of stable chest pain and has been used widely for almost half a century.[1] In the United Kingdom, exercise ECGs are a routinely performed, central part of patient assessment in most chest pain clinics, the main site of initial specialist referral.[2]

The 2010 UK National Institute for Health and Clinical Excellence (NICE) guidelines recommend that exercise ECGs should no longer be used to diagnose or exclude stable angina in patients.[3, 4] This recommendation is based on systematic reviews showing that other investigations have greater diagnostic accuracy [5, 6, 7, 8] and may be more cost effective at detecting people who are subsequently found to have coronary artery disease.[9] NICE recommends that the diagnosis of angina be based on clinical assessment alone or clinical assessment plus either anatomical imaging (e.g. coronary angiogram) or functional testing (e.g. stress echocardiography).

Medical technologies can have many functions beyond their explicit purpose.[10] Although technologies can distance the clinician from the patient, in some clinical settings they may facilitate a closer relationship.[11] Technologies, including diagnostic tests are not neutral; they embody specific cultural values and a range of implicit and explicit functions.[12,13,14] Ethnographic [15] and sociological [16] investigation of medical diagnosis reveals that this is a complex and often problematic process, in which the clinician combines results of diagnostic tests with the patient's narrative (structured as a clinical history), implicitly or explicitly forming, weighing up and testing hypotheses.[17] Clinical assessment and diagnosis takes place in specific settings in the context of a discursive and often physical relationship between clinician and patient. Guidance to clinicians needs to be informed by an understanding of this relationship and the clinical work of patient assessment, as well the diagnostic accuracy of symptoms, signs and tests.

OBJECTIVE

Given the widespread use of the exercise ECG in assessments of patients with stable chest pain, this paper seeks to understand its role in the light of emerging evidence about its poor performance as a diagnostic test. This paper reports on the functions of the exercise ECG in UK chest pain clinics, highlighting those uses that go beyond its diagnostic function.

METHODS

Participants, procedures and setting

This ethnographic study is part of a pilot for a randomised controlled trial of an intervention to improve chest pain diagnosis and management.[18] Participants were staff and patients in three English chest pain clinics: a provincial city centre hospital (A), a suburban city hospital (B), and a London hospital (C). These three hospitals were selected as contrasting sites in terms of the structure of their clinics, the ethnic diversity of their surrounding population and their engagement with research studies.

Observations

A total of 89 consultations between clinicians and patients with new onset stable chest pain were observed (by HC and ME) from July 2009 to June 2010. A sampling strategy of maximum variation was used to interview a range of clinicians (see table 1) about their current working practices, decision making processes and the role of different tests. A subset of patients were interviewed after the consultation to examine their experiences of the clinic, their understanding of the advice given and any behavioural changes they planned to make following their consultation.

Table 1: Summary of data collected

	Hospital A	Hospital B	Hospital C	Total
Participant observation				
Consultations observed	64	22	3	89
Meetings observed	6	3	0	9
Semi-structured interviews				
Staff				
Doctors	(3)	(1)	(3)	(7)
Cardiac nurses	(2)	(1)	(0)	(3)

Physiologists	(1)	(0)	(1)	(2)
Technicians	(2)	(0)	(1)	(3)
General practitioners				(3)
Patients	9	9	0	18

Half of the clinic consultations and interviews were audio-recorded and transcribed *verbatim*, half were recorded in detailed field notes. To distinguish in the text between the different types of data collection technique and data recording method the following conventions are used: all data collected by interview are indicated by [I]; all data collected by observation are indicated by [O]; audio-recording is indicated by [R] and the text for audio-recording is in quotation marks; data recording by written notes is indicated by [N] and the text for written notes is in italics. Data analysis was thematic, based on the constant comparative method [19] aided by the data management programme ATLAS ti.[20] HC and ME met regularly during the analysis to support consistency in coding, other members of the team (GF, KF and RJ) participated in further analysis. The analysis of the observational data was supplemented by and triangulated with data from staff and patient interviews.

RESULTS

In two of the three clinics (A and B) all patients who were able to do so performed an exercise ECG supervised by the clinician who took their initial history. In clinic C, exercise ECGs were only requested for selected patients and supervised by cardiac technicians.

Testing patient histories when wired up

Walking on the treadmill often stimulated symptoms that the patient had articulated in their initial account to the clinician and helped clarify the history (box 1, quote 1 and 2). The clinician asked further questions and the patient elaborated details, often enabling them to distinguish between different types of chest pain. In some cases the precipitation of symptoms such as palpitations on the treadmill supported the exclusion of angina (box 1 quote 3). Performance of exercise was also used to interrogate or contest other aspects of the history. For example a 62 year old man (P401, nurse S214 Hospital A [ONI]) described himself as a 'frequent walker', however, he had difficulty walking on the treadmill even at the slowest pace and incline (see also box 1, quote 4).

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Box 1: Testing patient histories when wired up**1. Patient P404, doctor S117 observed in Hospital A [ON].**

A man in his 50s with five risk factors, described dizzy spells, and non-exertional pain in his chest, arm and shoulder. A short time after starting to walk on the treadmill this patient reported chest pain:

Patient: *A little bit of chest pain.*

Doctor: *Like the one at home?*

Patient: *Similar.*

Doctor: *Just in the centre? Getting worse?*

Patient: *Yes.*

After the treadmill had stopped the doctor asked some further questions:

Doctor: *Giddy spells? Last 9 months?*

Patient: *I sit down and go white.*

Doctor: *Cold sweat?*

Patient: *Yes.*

Doctor: *That's important information.*

In discussion afterwards the doctor said that an angiogram would not have been ordered without the additional symptoms and information gained from using the exercise ECG.

2. Nurse S232, Patient P123 observed in Hospital B [OR]:

Nurse: "Well certainly talking to you before we even put you on the treadmill this all sounded very suggestive of the heart What this [exercise ECG] tells us is that there is a problem...and what we have seen today with this breathlessness and this tightness that you are getting, that the heart really isn't coping as it should be, so there are changes on the heart trace which [coughs] indicates something called ischemia".

3. Patient P102, nurse S214 observed in Hospital A [OR].

A woman aged 54 referred with non-exertional discomfort in her upper left arm and palpitations.

Nurse: "Well done [Beep] we've had your heart rate right up to about 170 there. How's it feeling now?"

Patient: Erm ...

Nurse: Have you got that same sensation as you ...

Patient: Yeah.

Nurse: ... have experienced before?

Patient: Yeah, it's really not as ... this is worse, sort of thing.

Nurse: Right [Beep] well I can say very reassuringly that that's ... look at that, that's bog standard sinus tachycardia, which is absolutely what should happen when you exercise".

4. Doctor S117, Hospital A [IR]:

"(T)he treadmill test is good [hmm...] it gives you a rough idea that the patient is telling the truth as well... So let us see how you do on the treadmill and then that gives us a good, good idea about his exercise ...sometimes they can't express as well, clearly... I mean they, they're not doctors so you ask them and they, they actually say I can't put, put a word as to how my pain is doctor. So, so it is difficult in that sort of situation you, you're not getting a good history [hmm...] but okay let's see what the treadmill test shows, that's what I think in my mind.... I think the treadmill test does give additional information".

Trust in exercise ECG as diagnostic aid

The language clinicians used when talking about the exercise ECG to patients was frequently that of evidence, certainty and diagnosis. For example *it could be angina and the treadmill test will quantify this* (nurse S214, P401 Hospital A [ON]) and *it looks normal, we got your heart rate up and no evidence that your heart is struggling* (nurse S232, P130 Hospital B [ON]). Trust in the diagnostic value of the exercise ECG is further reflected in the emphasis given to test results in discharge letters to GPs, for example “Results: This represents a positive exercise stress test. This result is diagnostic of CHD” (Hospital A). Generally, the exercise ECG was seen as a useful initial investigation: “as a first test you can’t beat that” (Doctor S117 Hospital A [IR]). Most clinicians also commented on limitations of the exercise ECG (box 2, quote 1). Nevertheless, despite universal acknowledgement of the history’s central role in diagnosis, clinicians expressed uncertainty and discomfort when the results of the exercise ECG contradicted rather than confirmed a patient’s history of typical angina (box 2, quote 2).

Box 2: Trust in exercise ECG as diagnostic aid

1.Nurse S215, Hospital A [IR]:

“I think the decision is when you’re with a patient at first, and whether you put them, like I said, on a treadmill to exclude a coronary pathology, or to reassure the patient... But also ...there is research that suggests that it’s useless doing it because it’s not a very sensitive test”.

2.Doctor S107, Hospital C [IR]:

“It’s the history taking that makes you decide ... sort of history is ninety percent ... I decide whether or not it sounds like it’s angina ...and the only real difficulty is then if the exercise tolerance test is either negative, that’s the only difficulty when it’s negative. If it’s equivocal it’s not such a problem because then they’ll still go on to have an angiogram, or a thallium, or something”.

Patient involvement in the diagnostic process

In many cases the exercise ECG had an important role in reassuring patients when the clinicians thought they had excluded a diagnosis of angina (box 3, quote 1). In cases such as this, performance of the test facilitated immediate reassurance and reinforced the message to patients that the pains they were experiencing were not symptoms of an underlying heart problem and it was safe for them to exercise (box 3, quote 2 and 3). In patients given a diagnosis of angina, using the exercise ECG facilitated the explanation of the diagnosis. This was based on the experience of symptoms during the test and of the clinician's response to the test output (box 3, quote 4).

The exercise ECG engaged patients directly in physical activity while being monitored by the clinician and via electrocardiography. This physical engagement of the patient through the expression and clarification of their symptoms, as well as their ability to watch the clinician's expression whilst observing their performance precipitated further dialogue (box 3 quote 5) and informed the shape and content of reassurance at the end of the assessment.

Box 3: Patient involvement in the diagnostic process

1. Physiologist S213, Hospital A [IR]:

"I think it's being able to exercise in a controlled environment with somebody there who's really going to push them a bit further than they would feel comfortable about doing outside and being able to take some recordings whether it's for their ECG or their blood pressure in that controlled environment they know they're safe ...yeah and then being able to tell them well you know you did really well there so don't be afraid of doing that level of exercise outside and you know and it's er everything was absolutely fine so it's about confidence, it's about allowing them to feel that those boundaries ...and maybe they could push themselves a little bit more".

2. Patient P402, nurse S214 observed in Hospital A [ON].

At the beginning of the consultation this patient was in tears. After walking on the exercise ECG the nurse showed her a 'perfect trace' adding *you should be very proud! Do you want the good news or the good news? You did brilliantly and your ECG is normal.* The nurse then went on to discuss diet and exercise with the patient, encouraging her to walk more regularly and checking for anxieties that might stop her from doing this.

3. Patient P331, nurse S214 observed in Hospital A [ON].

A woman was seen with a single episode of chest pain on exertion with no additional risk factors. After the history taking the nurse said *from what you described I'd be surprised if anything shows up.* The nurse stayed physically close by the patient during the exercise ECG and got her to engage in conversation. While still walking on the treadmill, after a routine blood pressure check the nurse said *that's grand, text book and heart rate just beginning to increase. And gaining in confidence, a little cloud is lifting.* As this patient left the consultation with a non angina diagnosis she said *thank you, it's peace of mind.*

4. Doctor S122, Patient P208 observed in Hospital A [OR]:

"You did fairly well on the treadmill. The ECG didn't show really much change. What we look for are symptoms and changes there, but the ECG part wasn't bad. You had a little bit of tightness there so there might still be a little bit of a problem there, we need to find out. The best way to look at that is by an angiogram".

5. Doctor S117, Hospital A [IR]:

"They feel it as well ...if they can't run they are puffing and they see their heart rate and see [that they are] not doing much ...it is visual yes, yeah it is visual [mhm] they understand every bit of it. I mean nothing is hidden... And they, they see everything and heart rate going up and coming down. I think err it's, it's really more a patient centred that's the best way to put it.... I mean they themselves can sort of interpret as well, 'I didn't do well [did I] doctor'?"

Facilitating behavioural advice

Performance of the exercise ECG gave the clinicians a context within which to recommend increase in exercise, change in diet and smoking cessation. Poor exercise performance was the basis of exercise and dietary advice in relation to weight loss. The exercise ECG performance was also used to reinforce healthy behaviours and the primary prevention of coronary artery disease (box 4, quotes 1, 2 and 3). Patients with a non cardiac diagnosis tended to receive exercise, diet and smoking advice whereas the focus with patients likely to have an angina diagnosis was on the next test.

As with diagnosis and reassurance, performing the exercise test opened up opportunities for discussion: "[I]t's live and I can explain as it's happening" (nurse S214, Hospital A [IR]). One clinician advised *currently heart rate going steadily shows a good base level fitness.....stop smoking* (nurse S214, P101Hospital A [ON]) and *what I see: heart rate gone up quickly and shows she is unfit, so will need to talk about stamina training* (P337- comment made through an interpreter). Whilst the patients were on the treadmill, clinicians were also able to refer to their walking to demonstrate the intensity of exercise they should be doing (box 4, quote 4) and to reassure them that it was safe to exercise (box 4, quote 5).

The exercise ECG necessitates the removal of clothes on the top half of the body and performing exercise in front of the clinician seems to prompt specific advice on exercise and weight loss (box 4, quote 6). Several patients after walking on the exercise ECG remarked that the treadmill experience or symptoms induced during the test and the discussion with the clinician had been important for them (box 4, quote 7). The strangeness of the hospital environment may also mean that the exercise ECG had a potentially greater impact on a patient being receptive to hearing advice about behavioural changes (box 4, quote 8). However, while some patients remarked in interviews afterwards that they fully intended to make changes in diet and exercise, others clearly expressed that they had no intention to do that.

Not all clinicians used the performance of the exercise ECG to give educational advice. When interviewed, some clinicians said that they thought lifestyle advice was important, but did not offer it consistently in practice. Within clinic C, where the exercise ECG was not routinely performed with all patients (Hospital C) and was not supervised by the clinician who took the patient's history, one clinician expressed frustration at the lack of opportunities to give lifestyle advice (box 4, quote 9).

Box 4: Facilitating behavioural advice

1. Patient P340, nurses S215 and S214 observed in Hospital A [ON].

After walking on the treadmill a nurse advised *[We can] can rule out [that it is not] not from your heart, [your] blood pressure is outside the normal range. [You are] carrying a bit more weight, I know [you have] a knee problem, follow this up with your GP. [We] don't want to clock up risk factors...suggest [you] do some weight loss, it affects cholesterol and blood pressure. Alcohol? [Patient nods] Suggest this is empty calories.*

2. Patient P338, nurse S214 observed in Hospital A [ON].

A patient with a strong family history expressed concern that she ran a greater risk of developing heart disease. After walking on the treadmill she was told she did have a greater risk of developing heart disease but that she was doing the all right things to reduce the risk *keeping yourself slim and active and not smoking and not much alcohol.*

3. Doctor S117, Hospital A [IR]:

No I wouldn't like to do without it [exercise ECG] because it really gives us many information not only about the ECG changes it tells us about heart rate response on exercise, blood pressure response on exercise and exercise capacity in general, patient's fitness... And that gives us a chance to tell about lifestyle modification....I mean that's an important message to drive home to the patient.

4. Patient P402, nurse S214 observed in Hospital A [ON]:

Nurse: *Normal walking pace?*

Patient: Yes

Nurse: *...brilliant well done. Is this like going to school in a hurry?*

Patient: Yes

Nurse: *Count this as exercise. You could do exercise like this, you need 30 minutes to do any good, need to get your heart rate up and keep it up.*

5. Patient P418, nurse S214 observed in Hospital A [ON]:

Nurse: *Like your normal speed? (Level I)*

Patient: *No it's faster*

Nurse: *You're walking too slow! Should be more like level II.... [And at the end of the consultation] Importance of regular walking, you can push yourself, it's all safe. Do like level II or III, so you are a bit short of breath...There is no wrong thing about exercise. There is nothing sinister about your heart.*

6. Patient P332, nurse S214 observed in Hospital A [ON].

During the consultation the nurse initially said *I can tell by your shape you are overweight.* Later whilst walking the treadmill the nurse remarked *I can feel you are getting out of breath, how's your chest?* When the patient replied that he has a pain in his back the nurse suggested that he pulled his stomach muscles in. At the end of the consultation, after a non angina diagnosis, the nurse said *you need to do more exercise and stop smoking.....no sign of angina. Let's keep it that way.*

7. Patient P125, Hospital B [IN].

During one post consultation interview a patient said that he understood the logic of the exercise ECG test in the sense that it could bring on chest pain *I cant think of any other way to generate the same problem.* He then said that in some ways would have liked to have experienced more pain during the exercise ECG so that he could have categorically said to the clinician *that's what happened and that's why I am here.*

Box 4 continued

8. Nurse S215, Hospital A [IR]:

"I think sometimes people when they come here, you see the difference that it's actually most times it hits home, and they think oh, this is quite frightening...Because it's a different environment. You know when you go to the GP it's a familiar environment, it's very much more kind of cosy, and don't get me wrong, I am not sort of dismissing the GP practice by any means, but I think when they come here, what I've seen so far, most people will listen to you carefully, because it kind of hits home..."

9. Doctor S107, Hospital C [IR]:

"that guy's a 40 year old, he shouldn't just be walking ten minutes to work and ten minutes back should he? I mean he should actually be exercising. ... You put them on a treadmill and they do four minutes and that's as ... the most they've walked ever...[it's] infuriating, because you can see that they've got risk ... if they stay the way they are, in ten years time they will be coming back with an MI....[but] with the clinic, you can't sit there and go through all their risk factors and stuff."

DISCUSSION

We have shown that in patients with new onset stable chest pain the exercise ECG has a role in articulating the clinical history through stimulating symptoms such as chest pain and breathlessness, and prompting additional narrative details about their symptoms. For patients in whom angina is discounted, walking on the treadmill is used to reassure them that their symptoms are not cardiac in origin and that it is safe to exercise. Performing the exercise ECG gives patients an active physical role in the diagnostic process. During and after the exercise ECG a context is provided within which the clinician can give specific advice on exercise, weight loss, diet and smoking cessation. If clinicians use the full potential of the exercise ECG, they may also draw on the patients' experience of walking on the treadmill to demonstrate appropriate levels of exercise and the amount of breathlessness they should be experiencing to improve their fitness. These specific benefits arise from exercising in front of the clinician and are not a function of the additional time spent with the patient.

Through the exercise ECG both patients and clinicians have the opportunity to become engaged experientially, transcending the test's diagnostic function, particularly when the clinician is present and able to supervise the test. This engagement is not usually present in functional tests for coronary artery disease that have better diagnostic accuracy, such as radioisotope scanning, stress ultrasound, or MRI, because even when exercise is the stressor, the test is almost invariably removed in time and place from the clinic setting. Although some clinicians talked about the additional functions of the exercise ECG, many of these were implicit and emerged from our observations. Most of the clinicians we observed believed that the exercise ECG did contribute to their diagnostic decisions [21], and so it is ironic that just as we were observing the exercise ECG at the centre of demonstrating professional authority and expertise, the legitimacy of that tool was being removed by NICE. Most clinicians also recognised the prognostic value of the exercise ECG when asked directly in interview, but this was not reflected in our observations of their clinical practice.

In this ethnographic study of chest pain clinics we have shown that the exercise ECG was being used for a range of clinical, psychosocial and educational purposes that potentially benefit patients. These benefits would be lost if the wider functions of the exercise ECG were not implemented through other means once the exercise ECG is phased out of the assessment of patients with new onset stable chest pain in line with the UK NICE chest pain guidelines. However, loss of its wider functions is not inevitable if a way is found to integrate the exercise stress used in more contemporary functional tests with the evaluation of the patient in the chest pain clinic.

Either with clinical assessment alone or assessment using other diagnostic technologies patients may find themselves in a passive and physically static role in the absence of a supervising clinician. There will, for example, be no opportunities for patients to walk briskly on a treadmill stimulating symptoms and no opportunities for patients to use their experiences when walking to engage in a dialogue of questions and clarification. This will weaken the embodied [22, 23] and performance aspect of chest pain diagnosis [24] that goes beyond verbal exchanges.[16] The communication of pain is often difficult,[25] and complicated by differences in gender [26] and ethnicity. Communicating chest pain is associated with additional anxieties.[27,28] As other studies have shown, [29] successful reassurance hinges on clinicians being able to indicate that they have understood a patient's current situation and can communicate this in the consultation. Our study suggests that through physical engagement the exercise ECG can facilitate communication between patient and clinician which, even if not improving diagnostic accuracy, does enhance subsequent reassurance.

Another important feature of exercise testing in two of the clinics we observed was the presence of the clinician making the assessment, often a senior nurse practitioner or staff grade cardiologist. This is not generally the case with other functional tests for angina which are conducted by a technician in a different space from the clinical assessment by a clinician. The splitting of a diagnostic test from the wider clinical assessment may affect the potential depth of the relationship [30] and the potential to clarify the clinical history through engagement with the test, particularly if this involves exercise.

Strengths and limitations of the study

1 A strength of our study is its ethnographic design incorporating the observation of patient-clinician
2 consultations and combining these data with interviews: we knew what participants did as well as said.
3 Looking at this gap between what people say they do and what they actually do is especially important
4 when exploring what lies beneath the rhetorical use of technologies to how they are used in everyday
5 practice. The fieldwork was undertaken at a key time just before the introduction of the NICE guidelines
6 and therefore provides an understanding of current practice that can inform their implementation. A further
7 strength is the combination of multiple perspectives from the wider research team of cardiologists, social
8 scientists, health service researchers and epidemiologists. A limitation of our study is that data were
9 collected largely from two chest pain clinics, potentially limiting the transferability of the findings, although
10 the clinicians in the research team thought that the clinics were not atypical compared to others had
11 experienced. Another limitation, due to time restrictions in the clinics, is that it was rarely possible for
12 clinicians to talk through their decision making for each patient, which would have deepened our
13 understanding of the role of the exercise ECG in this process.

14 **CONCLUSIONS**

15 As governments and professional bodies revise guidelines, the exercise ECG will have a diminishing role in
16 the diagnosis of angina. However, many of the practices that have been built up around the use of the
17 exercise ECG are potentially beneficial to patients and need to be considered in the re-design of chest pain
18 assessment services without that test. In particular, the supervised exercising of patients, even if this does
19 not explicitly inform diagnostic decisions or prognostic judgements, should form part of the assessment
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