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Qualitative study to explore the views of general practice staff on the use of point-of-care C reactive protein testing for the management of lower respiratory tract infections in routine general practice in England

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ABSTRACT

Objectives To explore the knowledge, skills, attitudes and beliefs of general practice staff about C reactive protein (CRP) point-of-care tests (POCTs) in routine general practice and associated barriers and facilitators to implementing it to improve the management of acute cough.

Design A qualitative methodology including interviews and focus groups using the Com-B framework to understand individuals' behaviour to implement CRP POCT in routine general practice. Data were analysed inductively and then aligned to the Com-B framework.

Setting A service evaluation of CRP POCT over a 6-month period was previously conducted in randomly selected GP practices from a high prescribing National Health Service Clinicial Commissioning Groups in England. All 11 intervention practices (eight accepting CRPs; three declining CRPs) and the eight control practices, which were not offered CRP POCT, were also invited to interview. A further randomly selected practice not allocated to intervention or control was also invited to participate.

Participants Seven of eight accepting CRP, one of three declining CRP and four of nine control practices consented to participate. 12 practices and 26 general practice staff participated; 11 interviews, 3 focus groups and 1 hand-written response.

Results Participants reported that CRP POCT can increase diagnostic certainty for acute cough, inform appropriate management, manage patient expectations for antibiotics, support patient education and improve appropriate antibiotic prescribing. Reported barriers to implementing CRP POCT included: CRP cost, time, easy access to the POCT machine and effects on clinical workflow. Participants with greater CRP use usually had a dedicated staff member with the machine located in their consultation room.

Conclusions CRP POCT can help general practice staff improve patient care and education if incorporated into routine care, but this will need enthusiasts with dedicated POCT instruments or smaller, cheaper, more portable machines. In addition, funding will be needed to support test costs and staff time.

Strengths and limitations of this study

- ► Qualitative research was conducted following a trial of C reactive protein (CRP) point-of-care tests use in routine general practices outside of a research setting; this sample reflects the true world of the NHS, a health service under pressure.
- ► Sampling methods led to a range of general practice staff participating, with a wide range of CRP testing, experience and views.
- ► Varying qualitative methods of enquiry with interviews, focus groups and hand written response conducted by one researcher, with double coding of 10% by a second researcher, allowed in-depth exploration of views and robust analysis
- ► Collecting data from other CCGs may have increased diversity of views; however, data saturation was reached with the sampling method.

INTRODUCTION

Tackling antimicrobial resistance is one of Public Health England's (PHE) seven priority areas aimed at protecting and improving the nation's health.[1] Optimising antibiotic prescribing practice by promoting better use of existing diagnostics is one of the seven key areas for action in *The UK Five Year Antimicrobial Resistance Strategy*.[2] In the UK, 70%–80% of all antibiotics are prescribed in the community[3] and around 23% of these are thought to be unnecessary or inappropriate.[4] Respiratory tract infections (RTIs) contribute most to inappropriate prescribing: sore throat (23%), cough (22%), sinusitis (8%) and acute otitis

media (6%).[4] Therefore, understanding how diagnostic practices influence antibiotic prescribing for RTIs in the everyday UK general practice setting is important to optimise appropriate use of antibiotics.

Point-of-care testing (POCT) has been used for many years as a medical diagnostic tool; results are available much more quickly than traditional laboratory tests and can improve patient care and satisfaction.[5] However, despite POCT availability and potential to improve patient care, POCTs are not extensively used in primary care in England. C reactive protein (CRP) testing is a form of POCT. The CRP POCT is performed from a finger-prick blood sample and analysed in approximately 4 min.[6] CRP, a major acute-phase plasma protein synthesised by the liver, binds to phosphocholine on bacterial and fungal polysaccharides and cell membranes facilitating immunological recognition of pathogens. CRP is produced in response to infection or tissue injury.[7] CRP is normally present at trace levels in blood but increases rapidly in response to a variety of infectious or inflammatory processes.[7] A high concentration of CRP in the blood is a sign that there may be an inflammatory process occurring in the body, and the patient may typically have a bacterial infection; low concentrations of CRP are typical of patients with a viral infection.[7] Combined with a clinical assessment, CRP measurement helps to differentiate between patients with a high or low risk of bacterial lower respiratory infection. Rapid tests for CRP were introduced into general practice about 20 years ago and are widely used as a POCT in the Netherlands and Nordic countries, mostly for RTIs.[6]

CRP POCT was incorporated into National Institute for Health and Care Excellence (NICE) guidelines CG 191[8] for the diagnosis of pneumonia in England in 2014 (box 1). NICE recommends that CRP POCTs should be considered when a patient presents with symptoms of lower RTI, clinical assessment is inconclusive and there is uncertainty whether antibiotics should be prescribed.[8] CRP POCT has been included in guidelines in some European countries including Norway, Sweden, the Netherlands, Germany, Switzerland, Czech Republic and Estonia; however, it should be noted that CRP is not widely used as a POCT in many countries including the UK and USA.

Box 1 National Institute for Health and Care Excellence (NICE) guidelines CG 191: pneumonia in adults: diagnosis and management

Presentation with lower respiratory tract infection

For people presenting with symptoms of lower respiratory tract infection in primary care, consider a point of care C reactive protein test if after clinical assessment a diagnosis of pneumonia has not been made and it is not clear whether antibiotics should be prescribed. Use the results of the C reactive protein test to guide antibiotic prescribing in people without a clinical diagnosis of pneumonia as follows:

- Do not routinely offer antibiotic therapy if the C reactive protein concentration is less than 20 mg/L.
- Consider a delayed antibiotic prescription (a prescription for use at a later date if symptoms worsen) if the C reactive protein concentration is between 20 mg/L and 100 mg/L.
- Offer antibiotic therapy if the C reactive protein concentration is greater than 100 mg/L.

Recent studies in the UK involving CRP POCT have been conducted including: a mixed methods study with acutely ill children that explores mainly parents' views on CRP POCT[9] and a case study with individuals aged 4–75 years in one general practice.[10] Qualitative studies specifically exploring the barriers and facilitators of using CRP POCT have also been addressed in the USA[11] and Europe and the UK.[6] However, no qualitative studies have been undertaken following a CRP POCT trial with adults (18–65 years) in multiple routine general practices in England who are not within a research network. Exploring the views of general practice staff in England on CRP POCT following a CRP POCT trial will provide a deeper understanding to the barriers and facilitators to using CRP POCT in routine general practice and inform future guidelines for primary care.

This study aimed to explore the knowledge, skills, attitudes and beliefs about CRP POCTs of general practice staff from a range of general practices following a CRP POCT trial in routine service provision. The study also aimed to understand the barriers and facilitators to implement CRP POCT in routine general practice and be the first study to understand the behavioural determinants required for successful CRP POCT implementation using the Com-B framework. This qualitative study is part of a wider service evaluation of CRP POCT for acute cough in routine general practices in Northern England.

METHODS

Research design

A McNulty-Zelen randomised controlled trial was conducted between February 2016 and July 2017 in a high prescribing CCG in North England. One CRP POCT machine was available to each eight intervention practices for 6 months; three practices rejected the offer of CRP POCT; eight were control practices.

At the end of the CRP POCT trial, all 19 practices were invited to participate in the present qualitative study; some practices accepted and some declined. This nested qualitative study directly followed the trial and collected data through interviews and focus groups between August 2017 and December 2017. This qualitative study explored the facilitators and barriers to using CRP POCT in routine general practice, why practices declined the offer of CRP POCT and views on general practice staff who have not trialled CRP POCT in routine practice.

Study setting

General practices in a high prescribing NHS CCG in England involved in a 6-month service evaluation of CRP POCT with a range of experience of using the tests. All 11 intervention practices (eight accepting CRP POCTs; three declining CRPs) were invited to interview. The eight

control practices, which were not offered CRP POCT, and a further randomly selected practice, not allocated to intervention or control, was also invited to interview to ensure a range of practices were included in the study. Only practices in the CCG were included in the study as the research followed a trial of CRP POCT in the CCG.

Participants

Participants included a range of practice staff from: intervention practices who had accepted the CRP POCT machine and had received standard training on how to use it by the machine manufacturer, including high (A), medium (B) and low (C) users; practices who were offered CRP POCTs but declined them (D); and control practices who were not offered CRP POCT machines were stratified into two groups by total antibiotic prescribing (STARPU in Q3 2016; classified for this study as very high if >800 and high prescribers <800). Control practices were placed in a random order using Excel rand functions.

In this study 'a range of general practice staff' refers to staff in the practice that would directly use the CRP POCT machine and/or would be indirectly associated with its use and management, that is, general practitioners (GPs), prescribing nurses, practice nurses, prescribing pharmacists, practice managers and healthcare assistants.

Patient and public involvement

Patients were not involved in this study.

Recruitment

The study recruitment process is outlined in figure 1 (insert figure 1). All practices were approached in random order until data saturation had been reached. The study aimed to recruit staff with a range of roles and experiences and intentions to use CRP POCT and through purposeful sampling.

Practice managers were invited by letter and telephone inviting a range of staff to participate. Study participation was incentivised with a £40 voucher for interviewees or £30 voucher for focus group participants.

Interview schedule

The interview schedule was developed by the project team, based on other qualitative work in this area[7 8 11] and piloted with one general practice staff member; no significant changes were made after the pilot interview, and therefore the data were included.

The Com-B behavioural framework[12] was identified prior to data collection as the most appropriate behavioural theory for this study. The Com-B framework was used to guide the interview schedule to understand staff capability, opportunity and motivation to use CRP POCT in routine general practice. Capability, opportunity and motivation are the three constructs of this framework that interact to generate behaviour and in turn also influences these components. Capability is defined as the individual's psychological and physical capacity to engage in the activity concerned, having the necessary knowledge and skills.[12] Opportunity is defined as all the factors that lie outside the individual that make the behaviour possible or prompt it.[12] Motivation is defined as all those brain processes that energise and direct behaviour such as habitual processes, emotional responding, as well as analytical decision making.[12] Further open questions outside the Com-B framework were also used to ensure all areas of practice were covered; this allowed inductive analysis.

Stage	11 Intervention practices; offered CRP POCT				9 Control practices; not offered CRP POCT		Total
	8 accepted CRP POCT			3 rejected CRP POCT	9 normal provision		20
Practices allocated to groups	Group A 3 practices "high uptake of CRP tests" >60 tests	Group B 3 practices "medium uptake of CRP tests" 10-60 tests	Group C 2 practices "low uptake of CRP tests" <10 tests	Group D 3 practices "rejected CRP POCT offer"	Group E 4 practices "very high antibiotic prescribing control"	Group F 5 practices "high antibiotic prescribing control"	20
Invited to interview	All 11 practices previously offered CRP POCT were invited to interview				9 practices not offered CRP POCT were randomised and approached in order		20
Practice level recruitment	3 accepted	3 accepted	1 accepted 1 rejected	1 accepted 2 rejected	2 accepted 2 rejected	2 accepted 3 rejected	12 accepted 8 rejected
GP staff level recruitment	5 GPs 2 Practice Managers 1 Prescribing Pharmacist 1 Healthcare Asstistant	3 GPs 1 Practice Manager 1 Practice Nurse	1 GP	1 GP 1 Practice Manager	5 GPs 1 Practice Nurse 1 Community Nurse	1 Practice Manager 1 Practice Nurse	15 GP 5 PM 3 PN 1 PP 1 CN 1 HCA
Data collection method	3 Interview 1 Focus Group	3 Interview 1 Focus Group	1 Interview	1 Interview 1 Hand written response	1 Interview 1 Focus Group	2 Interview	11 Int 3 FG 1 HWR

Figure 1 Qualitative study recruitment process. CRP, C reactive protein; FG, focus group; HWR, hand written response; POCT, point-of-care testing.

Box 2 Psychological capability quotes

Understanding of role of point-of-care testings (POCTs) and C reactive protein (CRP):

A point-of-care test is 'a test that you can do for the patient, while the patient's there and get the results back while the patient's there' (interview 8, general practitioner; low CRP uptake).

A CRP test is 'an inflammatory marker to test if the patient has bacterial infection and needed an antibiotic' (interview 7, general practitioner; low CRP uptake).

Decision making:

'It's not been easy to introduce because you have to remind staff. There isn't one in every room so the doctors will forget it's there' (interview 6, senior practice nurse, medium CRP uptake).

'We don't do a CRP routinely but probably once we get used to it in our consultation it will be easier and we'll do it more. I know there is a certain criteria when we need to do the CRP testing but we still probably forget about it, it's there, we need to use it, it probably will help us to make a diagnosis, will support our diagnosis or we rule it out' (interview 7, general practitioner; low CRP uptake).

Understanding CRP influence on prescribing:

'I think CRP definitely influenced prescribing during the trial. He (Prescribing Pharmacist) gave out fewer prescriptions for antibiotics than he would've done if he'd not used the machine' (interview 2; practice manager; high CRP uptake).

Cost effectiveness:

'CRP POCT would be cheaper for the health service in terms of reducing resistance and overprescribing' (focus group 3; general practitioner; control – very high antibiotic prescribing).

'The problem with it [CRP POCT] is there's not a cost saving, because the kind of antibiotics you would have used are penny ones' (focus group 1, general practitioner; high CRP uptake).

The Theoretical Domains Framework (TDF)[12] was used to help explain the behaviours required for successful implementation of CRP POCT and draw conclusions on appropriate interventions. The TDF is an extension of the Com-B at the centre of the behaviour change wheel described by Michie *et al*.[12] TDF describes 14 factors from theories of behaviour change that fall under the categories of capability, opportunity and motivation.

Data collection

Semistructured individual telephone interviews and face-to-face focus groups at the general practice were conducted and facilitated by lead author (CVE), an MSc experienced female researcher at PHE trained in qualitative research methods. Individual interviews were initially offered to practice staff, and if several staff from one practice wanted to participate in the study, then whole practice focus groups were a suitable data collection method. Interviews provided individual views, and focus groups provided whole practice views.

The interviewer did not know any of the participants prior to the data collection. Participants were aware of the aims of the qualitative study and that the interviewing researcher was from PHE. Introductory questions on staff demographics, that is, job role and how long they had been qualified were asked to establish baseline characteristics. A second researcher (AS or HL) was present to observe the focus groups and make field notes. Interviews lasted 15–37 min and focus groups lasted 21–33 min. One participant declined an interview but was happy to submit a hand-written response (449 words) to the interview schedule questions, which researchers accepted this form of qualitative data.

To ensure correct citation of the conversation, all interview and focus groups data were collected onto an encrypted recorder and anonymised. Audio data were transcribed verbatim by a third party transcription company and checked for accuracy by CVE; transcripts were not returned to participants. Interviews and focus groups were conducted until no new themes were emerging and data saturation had been reached.

Data analysis

NVivo software V.10 was used as a tool (by CVE) to organise and code the data for thematic analysis. Initial thematic analysis was an inductive, iterative process running in parallel to data collection. After seven interviews, a subset of the data (10%) was independently analysed by a second experienced researcher (DML) to ensure reliability. The researchers then agreed the main emerging themes.

Once the main themes were agreed, an additional data analysis stage was conducted, and the findings were applied to the Com-B behavioural framework. This was then discussed and agreed by the research team.

Ethics

Public Health England approval was granted by the Research Ethics and Governance Group[13] reference R&D 333. In line with NHS 'defining research' guidelines,[14] National Research Ethics Committee approval was not required as the study only involved National Health Service (NHS) staff. Participants provided written informed consent for participation in the research, audio recording and the publishing of anonymised quotes. Data were collected in line with the Data Protection Act 1998 and Caldicott 1999 regulations on handling and distributing sensitive participant information.

RESULTS

Seven practices accepting CRP, one declining CRP and four practices not offered CRP participated. Eight practices declined the invitation to take part in the study due to pressuring time constraints and practice workload.

A total of 26 general practice staff participated: 15 (58%) GPs, 5 (19%) practice managers, 3 practice nurses (12%), 1 prescribing pharmacist (4%), 1 community nurse (4%) and 1 healthcare assistant (4%). This included: group A high uptake of CRP: three practices and nine staff; group B medium uptake of CRP: two practices and three staff; group C low uptake of CRP: two practices and three staff; group D rejected CRP offer: one practice and two staff; group E control – very high antibiotic prescribing: two

Box 3 Physical capability quotes

Benefits of training

'I'd definitely recommend CRP POCT, but I think they've got to make sure that there's training for the people who are going to undertake it' (interview 1, prescribing pharmacist; high CRP uptake).

'From watching the demonstration when they [CRP POCT machine providers] came in to set it up, it seemed really simple and they were quite concise with the instructions. They brought leaflets and we made a flow chart. It seemed quite easy to use and very simple' (interview 2, practice manager; high CRP uptake).

'I think you need to be shown how to use the machine, shown how to do a simple finger prick test. But I think once you've been trained and shown how to do it, it's fairly simple to do'. (interview 8, general practitioner; low CRP uptake).

Confidence to conduct a C reactive protest (CRP) test

'I feel that I'm capable of taking CRP' (Interview 6, senior practice nurse; medium CRP uptake).

Explaining results to patients

'It's the interpretation of the results that may need the explanations to the patients. There are two levels of ability. There's the ability to actually carry out the test which may be fairly straightforward and then the explanation of the results to the patients and the subsequent treatment' (interview 9, practice nurse prescriber; control – high antibiotic prescribing).

practices and seven staff; group F control – high antibiotic prescribing: two practices and two staff. Eleven individual telephone interviews and three face-to-face focus groups were conducted; one hand-written response was provided (see figure 1).

The main themes from the interview and focus groups were applied to the Com-B behavioural framework and results are reported in terms of staff's capability, opportunity and motivation to use CRP POCT.

Capability

Psychological capability

Most staff had good knowledge and understanding of POCT and CRP testing, particularly staff in the intervention practices that had used CRP POCT. A few intervention staff (low CRP uptake) had poor memory, attention and decision processes as they advised they *'forgot'* that the machines were there and to use them; using the CRP machine was not part of their day-to-day clinical workflow. Staff from control practices had lower knowledge and understanding of CRP POCT; one GP in the control focus group asked, '*I don't know [how to perform the test]. Is it a finger prick blood test?*'. Most staff also had a good knowledge and understanding of the wider picture of how CRP POCT could influence inappropriate antibiotic prescribing. Many staff were interested in learning about the cost effectiveness of CRP POCT; both for the individual practice and for the NHS as a whole in helping to reduce antimicrobial resistance. Participant quotes related to psychological capability are in box 2.

Physical capability

All intervention practices reported receiving standard training from the machine developers. Six of the eight practices in the main trial asked to be trained for a second time to ensure that all staff were trained and to build on confidence; the two practices who only requested one set of training were high CRP users. Interviewed staff that had used CRP (high, medium and low users) had confidence in their skills to take a finger prick blood sample, conducted a CRP POCT correctly and had confidence in their ability to interpret the results appropriately. Staff, mostly from control practices with no experience of CRP POCT, would like training on how to use the machines to increase confidence and skills and ensure that all healthcare professionals are following the same protocol. All staff (intervention and control practices) reported that a range of health professionals including GPs, pharmacists, nurses or Healthcare Assitants (HCA's) would be capable of administering the finger prick blood test. Participant quotes related to physical capability are in box 3.

Opportunity

Physical opportunity

Opportunity offered by the environment to successfully conduct CRP POCTs was highlighted by all staff from all practices (intervention and control) in the form of barriers and facilitators. The main barriers reported by GP staff were: lack of financial support/reimbursement, lack of time in a 10 min consultation, difficult access to the CRP POCT machine and disruption to clinical workflow. However, facilitators to overcome these barriers were also reported by staff from the intervention high CRP testing practices: have one main staff member who sees patients with acute cough and conducts the test, have the CRP POCT machine accessible in their consultation room or

Table 1 Implementation of CRP POCT in intervention practices who accepted CRP machines

	Group A: high CRP uptake			Group B: medium CRP uptake		Group C: low CRP uptake	
Practice	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Registered patients	16878	6032	4291	4066	2139	2868	5866
Main user	Prescribing pharmacist	One GP	GPs/nurses	Practice nurse	GPs	GPs	GPs/nurses
Machine location	Pharmacists room	Nurses room	GP room	Clean store	Portable on a trolley	GP room	Nurses room

CRP, C reactive protein; GP, general practitioner; POCT, point-of-care testing.

Box 4 Physical opportunity quotes

Financial support:
'I don't understand the costs and implications of the costs on the practice; that could potentially be one of the barriers. It could be the cost of the testing and would the cost be down to the practice or CCG; that may be one of the obstacles' (interview 9, practice nurse prescriber; control – high antibiotic prescribing).

Time:
'My main issue in using it was the time constraints. In general practice ten minutes isn't much in an appointment and you can very quickly get behind with emergencies and complicated cases… adding the three min of the test to a general consultation and then bringing a patient back in from the waiting room, which takes more time, just made me more stressed and made me run later' (interview 8, general practitioner; low CRP uptake).
'You need at least 20 min appointment [to use CRP] for each patient which we [GPs] don't have' (interview 4, general practitioner; high CRP uptake).

Access:
'It was in my room, so I was the main person using it. Others felt that the access to the machine was a problem for them because we all are busy in our surgeries and you have to knock on the door, wait for me to come out, then they come in. It was easy for me because it was in my room and I could do it, I could tell the patient to go out and sit, I'll call you back in ten minutes; see the next patient in the meantime. So I was the one who used it most, and I would probably relate it to the access more than anything else' (focus group 1, general practitioner; high CRP uptake).

Incorporating into clinical workflow:
'We would make an assessment. I'd say 'I don't think antibiotics are likely but let's do a CRP test. Can you wander down the corridor, have that done with my Healthcare Assistant and if the result is positive, she'll let me know and I'll sort out a prescription for some antibiotics at the end of surgery for you.' That's how I see it working…. I think another barrier is training GPs to incorporate it [CRP] into a consultation' (interview 10, general practitioner; control – very high antibiotic prescribing).

Overcoming barriers:
'I'm a Senior Practice Nurse' and main user of CRP testing 'and my appointments are a minimum 20 min and the machine takes five min so it's OK' (interview 6; senior practice nurse; medium uptake).
'The machine was normally in this room and then if I needed it sometimes I'd bring the cartridge in here, or I'd wheel the trolley out' (focus group 2, general practitioner; medium CRP uptake).

on a moveable trolley and have a supportive workforce to adapt to changes in clinical workflow. Overall intervention practices who undertook the most CRP tests had one individual who saw all the acute cough patients and was responsible for conducting the CRP POCTs, that is, one GP, a prescribing pharmacist or a nurse. The machine was located in their room that meant that implementing CRP POCT into routine general practice became the social norm and part of the day-to-day clinic expectations; however, when that staff member was not in work, the machine did not get used. Table 1 describes where the CRP POCT machine was located in each intervention practice. Participant quotes related to physical opportunity are in box 4.

Box 5 Social opportunity quotes

Managing patient demand and expectations around antibiotics:
'When you've got patients demanding antibiotics, and certain individuals can be quite aggressive and quite demanding, CRP was a way for the doctors to say to them this is evidence based, the fact that antibiotics are not required' (interview 5, practice manager; low CRP uptake).
'Where I was unsure and where the patient was insistent, that's where I thought CRP test would be an advantage' (interview 4, general practitioner; high CRP uptake).

Patient education:
'CRP is a way of educating patients for the future' (interview 11, practice manager; control – high antibiotic prescribing).

Health professional–patient relationships:
'CRP gave the patients confidence that there was an independent scientific piece of machinery that was giving them an answer that they could see. They can't listen to their chest, they can't look down their throat, and they don't really know what's going on… If they can see the evidence themselves it gives them more confidence and it increases the trust in the doctor, that what the doctor is saying is what the objective evidence is also saying' (focus group 1, general practitioner; high CRP uptake).

Local and national guidance:
'We do follow NICE guidelines when to prescribe and when not to. We do follow criteria and we follow our examinations and the findings' (interview 7, general practitioner; low CRP uptake).
'I'm familiar with the NICE guidelines around CRP, about the less than 20, over 100 type figures, in terms of likelihood of a bacterial infection, therefore a prescription of antibiotics' (interview 10, general practitioner; control – very high antibiotic prescribing).

Social opportunity

GP staff discussed social factors including cultural norms and social cues that can influence an individual to conduct the CRP POCT behaviour, and despite varying levels of CRP use and experience, there was no difference reported between practice staff's views. Most GP staff, from both intervention and control practices, believed that CRP POCT can manage patient demand and expectations for antibiotics and can increase patient education around antibiotics. Staff from practices who had conducted a high level of CRP POCTs felt that CRP POCT improved health professional–patient relationships by improving patient trust and staff credibility by providing an objective measure to support clinical judgement. Staff from both intervention and control practices advised that they always try to work to local and national guidance available to them when deciding on treatment plans and whether to conduct a CRP POCT for an RTI. A few clinical staff commented on wanting to use CRP POCT in other presenting conditions including urinary tract infections or in patients with comorbidity factors such as chronic obstructive pulmonary disease. Participant quotes related to social opportunity are in box 5.

Motivation

Reflective motivation

Reflective brain processes such as plans and evaluations can activate or inhibit the CRP POCT behaviour such as staff's professional role, their intentions and beliefs about capabilities and consequences. All the nurses and the prescribing pharmacist who had used CRP POCT thought that they were ideally placed to conduct CRP POCT in routine general practice, as they regularly see the patients presenting with minor ailments, coughs and colds, generally have longer consultation appointments than GPs and have excellent relationships with patients knowing their medical history. The views of GPs were influenced by their perceived role in undertaking tests in the practice setting, and experience of using CRP POCT. Some GPs, especially the newly trained clinicians, were happy to conduct CRP POCT in their 10 min consultation and adapt their clinical workflow, whereas other, especially very experienced GPs and GPs in larger practices, advised that nurses, pharmacists or healthcare assistants would be best suited to conduct the physical finger prick blood test and if the staff member is not qualified. then the GP could interpret the results and prescribe if required. Table 1 explains who the main user at each intervention practice was.

Despite using the CRP POCT, staff had varying confidence in the accuracy of the CRP POCT machine and it working correctly. Most staff felt that the CRP POCT provided as accurate results as the CRP lab results and were confident with the results. Whereas one intervention practice with medium levels of testing felt that the machine provided too many error messages, this may be due to the low sample size or user error, which created frustration for the GPs and patients and led to a reduction in GP motivation to use it. Furthermore, this practice had their CRP machine on a trolley with wheels to make it portable and accessible that could have affected its validity.

Most interviewed staff across all practices believed that CRP POCT could reduce inappropriate antibiotic prescribing and believed that CRP POCT could be used as a diagnostic tool to support clinical decision making particularly in cases of uncertainty; at least one participant in each focus group also believed this and the majority of participants agreed. Overall, staff who had used CRP advised that the CRP test was most effective in patients where there was clinical uncertainty, rather than in cases where antibiotics were unlikely to be prescribed; the CRP POCT did not change clinical decision making overall but greatly assisted in cases where clinical assessment was inconclusive and there is uncertainty whether antibiotics should be prescribed. A few GPs reported that CRP POCT would not improve their antibiotic prescribing and they would not use it as a diagnostic tool in cases of clinical uncertainty; this was mainly experienced GPs who have been practising for a long time. Participant quotes related to reflective motivation are in box 6.

Box 6 Reflective motivation quotes

Professional role:

'Our healthcare assistant would easily do it [CRP test], they do blood sugar testing, and nurses, they use point of care INR tests…. As a practice we have to get together and have a better system for making sure that it was calibrated and switched on every morning and maybe in a place, a clinical area, that was accessible to everybody… having a better strategy for that would help it to be used more' (interview 8, general practitioner; low CRP uptake).

'Perhaps once in a blue moon but I would not plan to be an avid user [of CRP POCT]' (hand written response 1, general practitioner; rejected CRP offer).

Varying confidence in C reactive protein:

'We'd get a lot of error codes at the beginning' (interview 6; senior practice nurse; medium CRP uptake).

'I would be happy using it if the test was shorter, less errors, the machine was less cumbersome, and it's a very heavy machine that isn't it? And one [machine] in each room' (focus group 2, general practitioner; medium CRP uptake).

'From what I've read, what I've actually seen and from the theories, I'm very confident [in CRP]' (interview 9, practice nurse prescriber; control – high antibiotic prescribing).

Valuable to reduce clinical uncertainty and control antibiotic demand:

'CRP testing eases the clinical uncertainty around the decision making' (interview 5, practice manager; low CRP uptake).

'I think it's a great idea. We have high demand for antibiotics, particularly in the winter. And it would be very useful to have a tool that we could use in consultations to reinforce if we don't need to give antibiotics really. And that would be a very useful way of helping consultations run more smoothly and reduce antibiotic prescribing' (focus group 3, general practitioner; control – very high antibiotic prescribing).

Automatic motivation

Automatic motivation refers to automatic brain processes, emotions and desires associated with the behaviour to implement CRP POCT. Interviewed staff from most intervention practices felt that treatment decisions were supported by the CRP POCT and described emotional reasons why they would or would not implement CRP POCT in general practice. Despite CRP use, the emotional reasons were reported across practices and include: patient influences and pressures from a population where antibiotics is part of the culture, a fear of losing patients if the practice reduces their antibiotic prescribing rates and feeling '*undermined*' that regardless of the CRP result and the reinforcement from clinicians that antibiotic are not a suitable treatment patients will go '*antibiotic shopping*' and seek antibiotics from out of hours or Accident & Emergency Departments. Participant quotes related to automatic motivation are in box 7.

A summary of the main findings are reported in table 2, which summaries intervention practices views on CRP POCT implementation successes and lessons learnt and declined intervention practices and control practices views on how they would implement CRP POCT and their concerns on implementing CRP POCT in general practice. Generally, staff from intervention practices who had

Box 7 Automatic motivation quotes

Patient influences:

'I'm really trying to explain to patients about antibiotic resistance and where we're going to be in a number of years if we carry on. I think when you start to talk to patients in that way they tend to understand but I think what patients want is a quick fix and I think doing the CRP you're actually giving them that really' (Interview 9, practice nurse prescriber; control – high antibiotic prescribing).

'We do over prescribe because we've got a really unhealthy population. It's because we've got a population that thinks antibiotics are the answer to everything… antimicrobial resistance is not just the doctor's role, it's society as the general public have to take a different approach to how we manage simple conditions' (Interview 8, general practitioner; low CRP uptake).

Fear of losing patient trust:

'There's a culture of antibiotics; I remember once a GP practice cracked down prescribing antibiotics and they lost 25% of their patients within the year… But in the current environment if we decide not to [prescribe antibiotics] there's nothing to stop them to pitch up at A&E or the walk in centre and somebody there will probably give them something. All it does is it undermines what the practice was trying to do' (Interview 1, prescribing pharmacist; high CRP uptake).

If patients demand antibiotics and don't get them… 'Well, they'll go to the walk in centre, they'll rebook a couple of days later, they may even rock up at A&E' (Interview 3, practice manager; rejected CRP offer).

CRP supporting prescribing decision:

'He [GP] knew in his head what he was going to do but just to see what the machine will say just to support his decision making' (Interview 5, practice manager; low CRP uptake).

used CRP POCT knew more on the topic, compared with staff that had not used CRP much or the control practices.

The researchers found that all emerging themes fitted well into the Com-B framework that helped inform how staff capability, opportunity and motivation influenced their CRP testing behaviour (figure 2).

DISCUSSION

Principal findings

This qualitative research identified that most general practice staff with a range of CRP POCT experience view CRP POCT to be a useful diagnostic tool to manage patients presenting with acute cough. Overall, participants reported that CRP POCT can increase diagnostic certainty for acute cough, inform appropriate management, manage patient expectations for antibiotics, support patient education and improve appropriate antibiotic prescribing. The main reported barriers to implementing CRP POCT in routine general practice included: CRP POCT cost, time, easy access to the POCT machine and effects on clinical workflow. Participants with greater CRP POCT use usually had a dedicated staff member with the machine located in their consultation room.

The Com-B behavioural framework highlighted the key behavioural determinants required for successful implementation of CRP POCT. Training was considered very important by all staff and some practices required two sets of training. To support CRP POCT to become more widely implemented in England and applied in general practice, staff require training on how to optimise use of CRP POCTs to increase their knowledge, confidence and skills. The opportunities to conduct the CRP POCTs need to be considered including: CRP POCT machines need to be more time and cost effective and more accessible to all general practice staff. Staff will need to be motivated to use the POCTs; further recommendations for CRP POCT for the management of acute cough in national and local guidance should be an initial facilitator for behaviour change.

Strengths and limitations

A main strength of this qualitative study is that the interviews and focus groups were conducted following a trial of CRP POCT use in routine general practice service provision outside of a research setting. The qualitative data collection took place after 6 months' use of CRP POCT; therefore, the views of general practice staff are time relevant. The sample is based in a high antibiotic prescribing CCG in England, which may provide implications or on how other high antibiotic prescribing CCGs could improve implementation of CRP POCT. It should be noted that approaching only one CCG in England may have limitations to be unique to the UK NHS, and the socioeconomic status of the CCG may not be representative of the whole of the UK. However, every effort was made to recruit a representative sample; a range of general practice staff, with a range of CRP POCT use, some staff undertook many tests, others were initially enthusiastic and then did very few tests, some declined the CRP POCTs and other in the CCG were not offered CRP POCTs at all. This sample reflects the true world of the NHS, with varying acceptance and use of diagnostic tools.

Varying qualitative methods of enquiry were used; interviews brought an in-depth personal response, focus groups brought synergism, snowballing of ideas and stimulation of participants and the hand-written response allowed the participant to think in detail about their response. The open interview schedule with probing ensured that interviews and focus groups could be inductively analysed but also matched to the Com-B framework.

All data collection was conducted by one researcher, and to avoid acquiescence bias, the researcher did not use leading questions, instead open questioning techniques were used in the interview schedule. Furthermore, the researcher who conducted the interviews did not have any conflicts of interest and took care to not present opinions or attitudes so participants were able to voice their views freely. Data analysis followed a robust methodology as an experienced second researcher double coded a subset of the data.

Limitations of the study include that the study did not cover quality control of CRP POCTs in depth. One practice had many errors with the machine, which caused

Table 2 Summary of general practice staff views on C reactive protein (CRP) stratified by implementation rates

Practice group	Views on implementation successes	Lesson learnt from implementation
High CRP uptake	1. Training on CRP machines. 2. Funding available. 3. One main user of CRP point-of-care testing (POCT). 4. Machine located in main users room. 5. Prescribing pharmacists ideally placed to be main user (20 min appointments).	1. GP time is limited.
Medium CRP uptake	1. Training on CRP machines. 2. Funding available. 3. One/two main users of CRP POCT. 4. Machine located in a room accessible by all or located on a mobile trolley. 5. Nurses ideally placed to be main user (20 min appointments).	1. Lots of error readings reduced staff and patient confidence. 2. Smaller, lighter and portable machine required.
Low CRP uptake	1. Training on CRP machines. 2. Funding available. 3. Use National Institute for Health and Care Excellence guidance.	1. Many users cause problems. 2. General practitioner's have time constraints. 3. Healthcare assistant or nurse could administer the test. 4. Location of machine; needs to be accessible. 5. Forgot to use the machine; adapt into day-to-day practice. 6. Switch machine on every morning. 7. Check machine has been calibrated.
	Views on how to implement CRP POCT in general practice	**Concerns on implementing CRP POCT in general practice**
Declined CRP	1. Not feasible in a small practice.	1. Increase appointment length. 2. Reluctance to change. 3. Patients will go *'antibiotic shopping'* regardless of result.
Control practices	1. Training on CRP machine and interpreting results. 2. Locate in minor ailment clinic. 3. Access by all clinicians. 4. Adapt clinical workflow. 5. Use NICE guidance.	1. Time management in busy clinic. 2. Cost implications to the practice.

them to lose confidence in the machine; this may have been to a quality control issue. Another limitation was that 8 out 20 practices declined to take part in the study that may have raised different topics; however, data saturation was reached, and the study involved a range of practices. Researchers do not have an exact idea of how many tests a practice should be doing and therefore researchers stratified by the number of tests undertaken in the 6 months to attain a range of behavioural intentions. The high testing practices could have been doing too many; however, there is a lack of research to inform this. Further audits in the practice will help answer this question.

Comparison with existing literature

A multicountry study in research practices across Europe[15] and the qualitative phase of a large RCT in the Netherlands[16] found that advantages to GPs using POCT included managing patient expectations for antibiotics and feeling empowered to safely prescribe fewer antibiotics for LRTI, which is reinforced in the current study together with: increase patient education, improve health professional–patient relationships, support clinical decision making and reduce inappropriate antibiotic prescribing. A case study in one general practice in England[10] reported that CRP POCT influences prescribing within the primary care setting and patient education can be attained with CRP POCTs, supported by the views of our study population. Research from eight clinicians from Europe and the UK[8] and 30 clinicians from the US[11] highlighted barriers to implementing POC tests in primary care including: cost, test accuracy, over-reliance on tests and undermining clinical skills. While many of the same concerns were discussed in the current study, most, with the exception of cost, were not seen as barriers to implementing CRP POCT by most staff in the current study; undermining clinical skills was raised by one individual in the study however was not supported by other

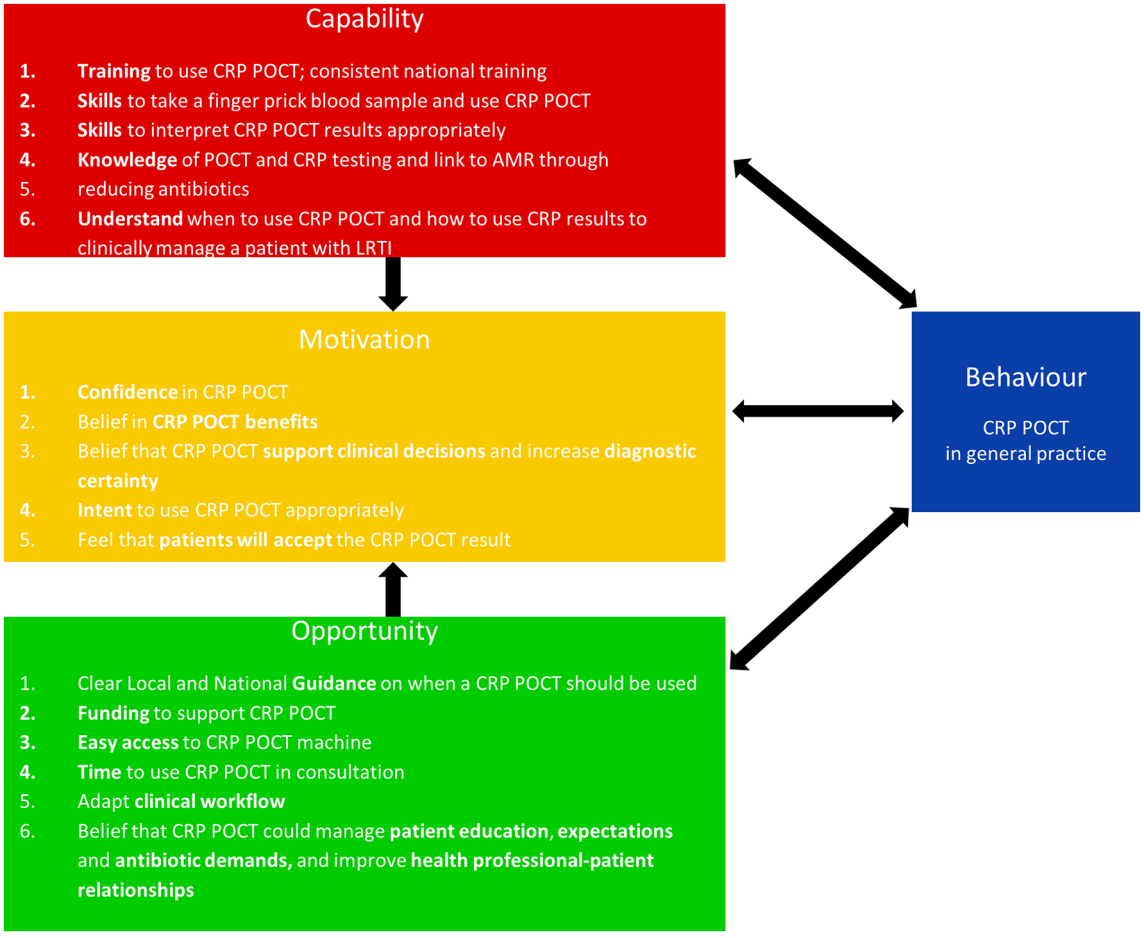

Figure 2 Behavioural determinants required for successful CRP POCT implementation in general practice using the COM-B framework. AMR, antimicrobial resistance; CRP, C reactive protein; LRTI, lower respiratory tract infections; POCT, point-of-care testing.

staff's views. This could reflect the differences in practice selection for the studies as our study was undertaken with practice staff who do not normally undertake research, and so their assessment of barriers may be different and less analytical. A UK mixed methods study in acutely ill children in two out-of-hours services explored parent, GP and nurse views and found that most supported wider implementation of CRP POCT and potential problems (cost, time, false reassurance, overtesting and parental expectations for testing) were not seen as major barriers to implementation.[9]

Most previous qualitative research was conducted in research practices in countries outside of England, creating uncertainty as to whether the results are transferable to a nonresearch setting with normal service provision in England. Our present study was conducted in a high prescribing CCG in England, outside the research setting in routine general practice, following a real-time trial of CRP POCT, with a range of general practices who implemented CRP POCT differently, with a range of GP staff with different roles in conducting CRP POCT, which previous studies have not explored. Even though all practices involved in the service evaluation were initially really enthusiastic about CRP POCT, this qualitative study explores the barriers and facilitators to implementing CRP POCT, why practices declined the offer of CRP POCT and views on general practice staff who have not trialled CRP POCT in routine practice.

Implications for commissioners of primary care services

This study indicates that introducing CRP POCTs across all general practices may be challenging, and therefore an initial facilitator for behaviour change will be needed for implementation of NICE guidance on the use of CRP POCT for the management of acute cough. Lack of funding/reimbursement to pay for the test and lack of staff to undertake it is a main barrier. NICE advised that the cost of the Afinion AS100 analyser is £1200, and Alere Afinion CRP test cartridges are £3.50 per test (excluding VAT).[17] In order to adopt widespread use across England, local and national funding should to be considered to address the barrier of a lack of financial support and staffing. The existence of clear guidance and training is very important for general practice staff both nationally and locally. Guidance is used by staff to manage how and when CRP POCT should be used in general practice, how to interpret results with clinical assessment. However, CRP POCT is only validated for use in acute cough, yet a

few clinical staff in this study discussed using CRP POCT outside of current NICE recommendations[11] for other conditions such as UTIs; this could lead to spectrum bias and unreliable results that are not yet evidence based.

Implications for practices

Optimising prescribing practice by promoting better use of existing diagnostics is one of the Department of Health's key areas for tackling antimicrobial resistance.[2] Therefore, our findings support this key area for action by indicating that GP staff are enthusiastic about the concept of POCTs, and informing how diagnostic practices like CRP POCT can help to optimise antibiotic prescribing in the everyday general practice setting. Several of the barriers highlighted by practices with low CRP POCT use in this study can be overcome by minor changes to training, access to the machine and work patterns. Training for the whole practice can ensure that all staff are actively aware of CRP POCT and have a good understanding of the test. Access can be improved by locating the machine in the main user's room or having it in a room that is accessible by all staff so not to disrupt other staff's workflow or producing smaller, less costly machines. Clinical workflow can be adapted by having one main user of CRP POCT who sees most patients with acute cough, perhaps a nurse or prescribing pharmacist; this works especially well in large practices. In practices with very low testing rates, consider developing a whole practice approach to using CRP POCT to review successful implementations locally and nationally. In practices declining to use tests, consider providing additional staffing support to aid the time constraints that were highlighted as a key barrier to accepting CRP machines.

Implications to manufactures of POCTs

To see an increase in the implementation of CRP POCT in routine general practice, it is suggested that further research and development of smaller, portable CRP POCT machines in order to help overcome time, cost and access barriers.

Implications for future research

While staff suggest that CRP POCT supports patient education around appropriate treatment options, and this was a behavioural component of implementing CRP POCT, this element is not the main role of CRP POCT and further work is required to educate the general public on antimicrobial stewardship and to tackle the current antibiotic culture.

This study did not cover CRP POCT in children and older adults as the test is not validated for use in primary care in these age groups. Therefore, further research on the effectiveness of CRP POCT is required in children and in older adults, and also in patients with long-term health conditions. Health economics of CRP POCT is required to assess the economic impact of adopting CRP POCT into general practice as some staff in this study were sceptical about its cost-effectiveness and most were interested in learning more about its cost effectiveness and the long-term cost benefits to the NHS.

CONCLUSION

CRP POCT can help general practice staff improve patient care and education if incorporated into routine practice; however, all practices need the knowledge and skills for implementation, and opportunity and motivation are still barriers in many practices. Increasing staff members' knowledge of the benefits through education, skills through modelling, role play and action planning and motivation through incentives such as audit, benchmarking and quality premium, and opportunity through better provision of machines or smaller, cheaper and more portable machines are required for successful implementation. In addition, funding will be needed to support test costs and staff time. This study's COM-B framework for CRP POCT can aid further implementations. CCGs and individual general practices considering implementing CRP POCT can review the behavioural determinants highlighted in this study's Com-B framework for CRP POCT to provide a guide for successful implementation.

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