Strategies To Implement SARS-CoV-2 Point-of-Care Testing Into Primary Care Settings: A Qualitative Secondary Analysis Guided By The Behaviour Change Wheel

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Abstract

Background: There is little empirical evidence to inform implementation strategies for introducing SARS-CoV-2 point of care (POC) testing into primary care settings. The purpose of this study is to develop a theory-driven understanding of the behavioural determinants underpinning the implementation of SARS-CoV-2 POC testing in primary care. This will allow identification of potential intervention strategies that could encourage successful implementation of testing into routine practice and facilitate face-to-face consultations.

Methods: We used a secondary qualitative analysis approach to re-analyse data from a qualitative study that involved interviewing 22 primary care physicians from 21 primary care practices across three regions in England. We followed the three-step method based on the Behaviour Change Wheel to identify barriers/enablers to the implementation of SARS-CoV-2 POC testing and identified behaviour change techniques to inform intervention strategies that targeted the barriers/enablers.

Results: We identified 10 barriers and enablers to POC implementation under eight Theoretical Domains Framework (TDF): (1) knowledge; (2) behavioural regulation; (3) reinforcement; (4) skills; (5) environmental context and resources; (6) social influence; (7) professional role and identity; and (8) belief about consequences. Linkages with the Behaviour Change Techniques (BCT) taxonomy enabled the identification of intervention strategies to address the social and contextual factors influencing primary care physician's willingness and capacity to adopt POC testing.

Conclusions: A theory-informed approach identified barriers to the adoption of POC tests in primary care as well as guiding implementation strategies to address these challenges.

Contributions To The Literature

- Current work on point-of-care tests to detect SARS-CoV-2 does not provide insights into strategies to guide how the devices can be implemented into real-world clinical settings.
- We used established behavioural science methodologies to identify barriers and enablers to the implementation of SARS-CoV-2 tests into the primary care pathway.
- We demonstrated the use of theory to develop strategies to support the feasibility of primary care to conduct SARS-CoV-2 POC testing with the goal of increasing face-to-face consultations.

Background

The unprecedented disruptions of the SARS-CoV-2 pandemic has forced a paradigm shift in the way primary care operates, with several core functions being reorganised to facilitate remote-first care services with face-to-face consultations only being offered if considered necessary (1, 2). Although these changes created new opportunities for patients to quickly and conveniently access care (3–5), evidence has shown that remote consulting can lead to diminishing personal connectedness between physicians and

patients, loss of ability to perform targeted physical examinations, and an increase in workload pressures for physicians (6–9). Moreover, some patient groups may not have access to, or the ability to use, appropriate technology to participate in remote consultations (10, 11). Revising national guidance to encourage the increase of face-to-face appointments may help address these challenges but will require a multifaceted approach to minimise the risk of contagion while vaccine programmes continue to be rolled out.

Considering this, point-of-care (POC) tests for SARS-CoV-2 can play an instrumental role in enabling more face-to-face consultations as the disease enters a more endemic phase. POC tests for SARS-CoV-2 can help provide real-time and on-site detection of SARS-CoV-2 infection without the need for specialised laboratory equipment (12, 13). Primary care physicians (PCPs) can increase the volume of face-to-face clinical encounters and use POC tests during (or very close to) the time of consultation to detect and prevent contagion within the clinic (14). Additionally, POC tests can act as a safety measures to control and contain risk in view of the uncertainties concerning the real-world efficacy of different vaccines (15), new variants of concern (16,17), complexities of vaccine hesitancy (18,19).

Evidence relating to the implementation of POC testing in primary care settings is limited. Much of the work on SARS-CoV-2 POC tests has focused on modelling clinical and economics impact of those tests (20), which limits the generalisability of findings to real-world settings (21). More work is needed to examine the range of complex socio-behavioural processes and dynamics that PCPs encounter when changing their work to accommodate new practices, as new interventions can change their work environment and introduce deviations from routine behaviours, alter roles, and shift responsibilities of work (22–24).

Behavioural science frameworks provide a structure for integrating different evidence sources to systematically identify factors that explain and influence behaviour. This enhances understanding of the relationship between behaviour and interventions and thus informs evidence-based intervention strategies (25–28). It can reduce the risk of inadequacies in research design, conduct and dissemination that may result in 85% of healthcare research being ‘wasted’(29). This approach can help address this translational gap (30). Thus, a theoretically structured approach may support the design, replicate or even improve evidence-informed implementation strategies (31). Evidence from behaviour change research can assist in improving the adoption of new practices (32). Importantly, the use of this theory has been recommended by the UK Medical Research Council (MRC) guidelines for developing and evaluating interventions as a means to increase intervention effectiveness (33). To the authors’ knowledge, no research has explored the use of theory-driven studies to examine and understand the behavioural barriers to adopting SARS-CoV-2 POC tests, how barriers to these behaviours may be addressed, or how interventions can be developed to better facilitate the implementation of testing into routine practice.

To address this gap in knowledge, we used one such approach, the Behaviour Change Wheel (BCW) (34), to guide the study, and drew from the Theoretical Domains Framework (TDF) (35), and Behaviour Change Techniques Taxonomy (BCTTv1) (36), to strengthen the link between theory, targeting interventions, and

implementation planning (37). We describe these models and frameworks in more detail in the methods section.

The BCW is a systematic tool that helps researchers transition from the behavioural diagnosis of a problem to designing and evaluating interventions to facilitate behaviour change. We opted to use the BCW as it was developed from a broad range of nineteen multidisciplinary frameworks (38), and builds upon the MRC guidance and offers a practical guide of how to develop theory and evidence-based intervention (33).

The BCW consist of three core components: The first component at the centre of the BCW is the COM-B model, which is used to frame the behavioural diagnosis by highlighting that behaviour is influenced by three essential conditions: Capability, Opportunity and Motivation (34). Further elucidation can be explored by using the Theoretical Domains Framework (TDF) (35, 37), which was added to the BCW to help further unpack the COM-B (38, 39). The TDF is a meta-framework comprised of 14 theoretical domains (such as 'Knowledge', 'Skills', 'Intentions' and 'Social Influences') derived from 33 validated health and social psychology theories and over 128 behavioural change constructs designed to enable the systematic assessment of implementation issues to inform intervention design (35, 37). It is a useful approach to understanding behaviours in diverse healthcare settings and was developed to support the implementation of new healthcare practices requiring behaviour change (40–44). The second component of the BCW represents nine general types of interventions and a third component is policy categories to support implementation. Recommended strategies to support interventions to achieve their functions can be achieved using the BCTTv1, which lists theoretically informed or evidence-based behaviour change techniques to aid in the selection of intervention content that target behaviours hypothesised to facilitate change (25, 34, 36, 45, 46). The taxonomy includes 93 behaviour change techniques grouped within 16 categories, and several studies have applied the BCW and BCTTv1 to develop implementation interventions (47–49).

The purpose of this study is to develop a theory-driven understanding of the behavioural determinants underpinning the implementation of SARS-CoV-2 POC testing in primary care to identify potential intervention strategies that could encourage the successful implementation of testing into routine practice with the goal of increasing face-to-face consultations.

Methods

Design and setting

We used a qualitative study design to investigate perceptions of implementing SARS-CoV-2 POC testing among Primary Care Physicians across three regions (London, Thames Valley and South Midlands, North East and North Cumbria) in England. The qualitative approach enabled us to explore, explain and describe complex processes and behaviours within the context in which they occur (50). This work is part of a qualitative study that originally sought to better understand the theoretical construction of where SARS-CoV-2 testing would ideally fit within the patient care pathway (51).

Although the research questions of this study were not explicit topics of the initial qualitative study, many themes relevant to behaviour change and the implementation POC testing were raised by PCPs during the interviews. Therefore, the material was appropriate to elicit new answers to the current objective of this study. As such, we conducted a qualitative, secondary analysis of the data in order to examine our existing data to answer new research questions guided by the BCW (52).

The Consolidated criteria for Reporting Qualitative Research (COREQ) was used to structure the reporting of the methods and results (53).

Procedure and source of data

The body of empirical data for the secondary analysis came from transcripts and notes obtained from 22 semi-structured interviews between September 2020 to November 2020. Study participants comprised a purposive sample of PCPs from 21 primary care practices across three regions in England. They were recruited with the assistance of three NIHR Local Clinical Research Networks (LCRNs). Participants were diverse with respect to age, years in practice, practice type, and geographical location (see Table 1). Interviews were conducted until we were confident that no new experiences or beliefs emerged (54, 55).

Table 1
Demographic features of participants and characteristics of study sites

Participant characteristics	Number
Total number of participants	22
Sex	
Male	12
Female	10
Medical training	
Average time post qualification (years)	18
Range of qualification time [Median] (years)	1–30 [19]
Study site characteristics	
Region of practice	
Thames Valley and South Midlands	9
London	4
North East and North Cumbria	8
Number of patients registered to practice, mean	14522 (3600–40,000)
Practice setting	
Urban	7
Suburban	1
Rural	5
Mixed	8

All interviews were conducted online by four members (one male postdoctoral fellow, one female senior researcher, one female senior lecturer, and one male clinical scientist) of the research team who are experienced in qualitative methods applied to the domains of health services research (PK), diagnostics evaluation methodology (JA), biomedical engineering (TH), and health economics (YY). A semi-structured interview topic guide was used which was designed to prompt more detailed discussion led by the participants. The interviews, which lasted 45–60 minutes, were video recorded using Microsoft Teams videoconferencing software, then transcribed verbatim using the Otter.ai software. Only one interview was not video recorded as the participant did not consent to being recorded. Notes were recorded for that interview and included in our data analysis. To ensure rigour, all interview transcripts were checked against audio recordings. All recorded data was de-identified.

Participants were not compensated by the study team for participating in the study. All participants who participated in the study provided informed verbal and written consent.

Data analysis

The study followed three stages (1) understand the behaviours; (2) identify intervention options; and (3) identify content and implementation options, as recommend when using the BCW.

Stage 1: Understand the behaviours

We used a combination of inductive and deductive approaches drawing from thematic analysis (56) to understand the challenges of implementing POC testing into routine care practice. An inductive approach was used to thematically analyse the data using the NVivo 1.3 software (QSR International). After reading through the entire dataset, the first author (PK) developed the initial codebook where themes were developed based on pattern prevalence across the data. Four team members (PK, TH, AJA, YY) met to refine the codebook and discuss potential themes and subthemes and define a consensus coding scheme (e.g., codes, definitions of codes, examples of quotes under each code). Thematic saturation was achieved when the research team judged that no new themes had emerged from the data (57). The team proceeded with coding three more interviews and met again to discuss any new themes, resolve uncertainties, examine for any convergence and divergence. Following this, all researchers coded the remaining interviews and met on a weekly basis to regularly check for consensus on coding. Discrepancies were solved through discussions until a consensus was reached with reference to the coding manual.

In line with previous qualitative studies, a deductive approach to match themes to the appropriate 'domains' within the TDF to identify the determinants of behaviour (58–60). During this stage, the first author (PK) re-read the data within the codes, allocated the themes to the appropriate TDF domains relevant for behaviour, and generated 'belief statements' across the domains that reflected the core beliefs expressed by the codes (35, 38). To increase reliability of the assignment of themes relevant TDF domain, a second coder (TH) independently mapped the themes to TDF domains until we were confident that there was agreement discussion to produce a 'behavioural diagnosis' (barriers and facilitators) for implementing POC testing into primary care. Discrepancies were resolved through discussion resolved. A third researcher (AJA) checked the codes and their relevance to each TDF domain. All belief statements were verified by each analyst and adjusted for consensus. Any situations where a theme was mapped to one or more domains was discussed with a third team member (AJA) to reach consensus. The identification of key domains considered likely to influence adoption were identified via three-pronged process. TDF domains that were considered of high importance based on frequency of beliefs across the 21 study participants, (2) presence of conflicting beliefs in the domain, and (3) perceived strength of the belief that is believed to directly impact uptake (determined by consensus among the research team) (35).

Step 2: Identify intervention options

In the second part, intervention functions were identified that targeted each TDF components. Two members of the study team (PK, TH) used an iterative process to and identify the most appropriate intervention functions. Our discussions were informed by the relevant literature and previous SARS-CoV-2 POC implementation and adoption studies conducted by the authors of this study (61–63). We proceeded with our behavioural analysis to identify and specify what internal and external conditions and actions needed to change to address each target behaviour identified in the empiric data. This involved two members of the team (PK, TH) identifying the theoretical constructs from the TDF that needed to change for each specific behaviour to occur and most appropriate mode of delivery of each technique. These were then discussed with a third research team member (AJA) for consensus. To inform this process, we relied on the experience of the research team including clinicians, diagnostics specialists, and social scientists, together with feedback from other clinical colleagues to identify potential intervention options.

Step 3: identify content and implementation options

Barriers and enablers coded to the TDF constructs were mapped to corresponding intervention types and behaviour change techniques paired the TDF with intervention types in the BCW and taxonomies in the BCTTv1 (34, 45). Two members of the team (PK, TH) developed specific intervention strategies using information gathered from the qualitative interviews, literature on implementation strategies focused on changing professional practices or behaviour in primary care (64–66), and our understanding of the context of what would be feasible to implement by consulting with clinician colleagues. We used the APEASE criteria (Affordability, Practicability, Effectiveness/cost-effectiveness, Acceptability, Side-effects/safety, Equity) to guide context-based decisions on the selection of appropriate intervention content (34). This was further refined through member checking with colleagues (incl. primary and secondary care physicians) with clinical knowledge in diagnostics to verify the intervention strategies based on their perspectives on what could work based on the context of the study (67).

Results

Stage 1: Understand the behaviours

The analysis identified eight domains of the TDF components that were relevant to nine themes thought to influence the PCPs perceptions on the implementation of POC. The TDF domains included: (1) knowledge; (2) behavioural regulation; (3) reinforcement; (4) skills; (5) environmental context and resources; (6) social influence; (7) professional role and identity; and (8) belief about consequences. Table 2 provides an overview of how the themes, belief statements, and occurrences are mapped to the TDF domains.

Table 2
Determinants to POC test implementation: TDF domains identified and the corresponding key themes and belief statements.

TDF	Themes	Belief Statements
Knowledge	Limited knowledge of the SARS-CoV-2 POC testing landscape.	I am/am not familiar with POC tests and how they work.
	Scepticism about the insufficient evidence.	I am/am not confident about the current evidence base.
Skills	Professional education and training.	I do/do not need training support to learn how to operate the tests safely and consistently.
Behavioural regulation	PCPs would adopt POC tests if prescribed by authorities.	I would/would not implement testing if asked to do so by local/regional/national authorities.
Reinforcement	Financial incentives.	I would/would not perform testing if I am paid to do it
Environmental context and resources	Limited workload capacity.	I do/do not have time and resources to perform extra tasks.
Social influences	Information sharing across practices.	I am influenced/not influenced by the opinions of my colleagues and information shared on social media platforms.
Professional role and identity	Society will view primary care as an alternative to community testing centres.	I am/am not worried that healthy members of the public will view us a testing facility.
Beliefs about consequences	Perception of assurance/risk.	I will/will not feel safer about face-to-face interactions with patients.

Mapping of themes with the Theoretical Domains Framework

Knowledge

PCPs had limited knowledge of the SARS-CoV-2 POC testing landscape. This acted as a barrier as they were unable to identify the advantages or disadvantages of implementing POC tests into practice.

“I think there is a huge gap in knowledge around what point-of-care, antigen tests look like, how they work, the level of confidence we can have in the results and we're hearing that even reading the results is variable.” (GP 21)

There was some scepticism about the insufficient evidence around the use of the tests and to confirm the validity of the devices.

“It seems that most of the devices seem to be on based on a lateral flow model and I am not aware of any that have sort of received proof that they are valid and can be used as a decision-making tool in

clinical practice. But as I say, I've not sort of looked into detail about what there is more broadly out there." (GP 08)

Skills

Although PCPs had some experience with providing service for other respiratory conditions requiring sample collection, they expressed the need for some support in terms of 'professional education and training' to operate the tests efficiently.

"All the people that work in the practice can take blood and do swabs, and quite a lot of us do respiratory stuff, spirometry and other breathing things. With simple training, we should be able to manage a point of care test that is simple, and it's making sure it can be done repeatedly and accurately". (GP 16)

PCPs mostly referred to the need for health care assistants (HCAs) to receive training and take on the role as the main operators of the test.

"I think it'd have to be a health care assistant specifically trained up to do that… it's a skill that needs to be learned, but it's quite a simple one. You need someone who's focused on just that one problem" (GP 15)

Behavioural regulation

Official guidelines or recommendations to provide POC testing meant that PCPs would adopt POC tests if prescribed by authorities.

"If it was recommended by Public Health England or NICE, I think we would follow the guidelines. And the problem is that they are just changing so quickly, we have to rely on you know, the sources we've got available. So yeah, so if I think Public Health England said to us this test is a good test. You're all using it, and then we'd have to trust it." (GP 02)

Another elaborated that they are obligated to follow guidance issued by their Clinical Commissioning Groups.

"General practices operate under the guidance from the local CCG and obviously the local CCG get advice from the NHS England in terms of what how we respond, and how we deal with things really. So, you would say the system level of how we operate is always based on the instruction there." (GP 11)

Reinforcement

Physicians mentioned that they would integrate testing into practice if they received financial incentives.

"If you provide the machines, and you provide the consumables, and you pay for our time, we will do it." (GP 01)

Environmental context and resources

PCPs had limited workload capacity and were concerned that testing would add to existing pressures they already face. Existing work would need to be alleviated or compromises would have to be made to create capacity for testing.

“If we're adding something new in… say there's no new money, which too often isn't, something else has to be taken away. It's just not feasible to carry on doing everything and add in an extra thing.” (GP 04)

For many, there was a need for additional funding to hire extra staff and additional expenses associated with testing.

“Adding point-of-care testing for COVID positive patients to our surgery, without adding staff and space…it won't work.” (GP 14)

Social Influences

Participants discussed the influences of information sharing across practices on their perception of POC tests. For instance, some PCPs mentioned that they were wary of POC tests based on the concerns expressed by colleagues.

“But I think the general feeling I have, and I think most of my colleagues in the practice have is a lot of concern about that are they validated, and things like that, and our feeling, probably, broadly speaking, would be that it's widely talked about by the government, but that would seem to be a political exercise.” (GP 08)

PCPs also mentioned that information is regularly shared across technologically mediated communication platforms such as WhatsApp and Facebook.

“In terms of diagnostics, people have talked about it, but I've not really seen any kind of evidence-based information in those groups [social network platforms] yet about if there is one available for rapid testing. I mean, people have talked about that, posted articles which have been in the media.” (GP 10)

Professional role and identity

Most interviewees perceived that the responsibility for administering POC testing should not primarily fall within the remit of primary care. There was a general feeling the society will view primary care as an alternative to community testing centres.

“There's a risk that we will start to get an increased demand of having a doing testing on people who are on have would fit in that category of mild symptoms and not needing a face-to-face appointment and that obviously has resource implications in terms of time and staff and staff costs from salaries.” (GP 08)

Another explained why they thought the change in perception would happen,

“From a patient's perspective, not surprisingly, that is very attractive. So, it doesn’t take a genius to work out that if you as a patient can get a near patient test for COVID, that's going to be a very attractive commodity for patients.” (GP 05).

Beliefs about consequence

PCPs believed that the perception of assurance/risk played an important role. If the devices assisted them ruling-in and ruling-out potentially infectious individuals, they would feel more confident about the benefits of POC tests and face-to-face appointments.

“It will make us more confident in face-to-face consultations. We've got a huge population with respiratory illness, especially COPD. I think these are the patients who kind of have missed out on getting seen, because any respiratory symptom they have an exacerbation, we really are relying on our clinical acumen and a kind of basic saturation maximum. Because we tend not to bring them in. So, these are the kind of patients especially with respiratory symptoms, who would benefit from a rapid testing, because then we can actually see them, or the patients who have weak symptoms who we don't know if they have got COVID or not.” (GP 10)

However, several expressed concerns about occupational exposure. POC testing would equally place the practice staff at higher risk of getting infected and losing manpower.

“One of the key vulnerabilities in this is the sustainability of the general practice service. You know, what we want to do is make sure that we don't lose people, we don't have to self-isolate... So, we're losing manpower, and therefore productivity and sustainability.” (GP 21)

Stage 2 and 3: Identify intervention options, content and implementation options

As outlined in the methods section (step 3), seven intervention functions from the BCW considered useful included ‘education’, ‘persuasion’, ‘training’, ‘enablement’, ‘incentivisation’, ‘environmental restructuring’, and ‘restriction’. The most common were ‘persuasion’ and ‘education’, which largely addressed the influence of knowledge and the role of information sharing. Following this, we used the 93-item BCT taxonomy to identify 18 specific behaviour change techniques to map to the intervention function that we considered would be relevant in a future intervention. Examples of intervention functions for ‘training’ was mapped to the BCT technique ‘instructions on how to perform the behaviour’ to target staffs need for training support in learning how to use POC tests. The most common techniques used were ‘Information about social and environmental consequences’ (e.g., Provide evidence-based information to cultivate confidence in the quality of POC tests). On this basis and as described in the methods, intervention strategies were further developed and refined through discussion with a groups of physician colleagues who were part of our member checking team and were knowledgeable in care pathways analysis and evaluation of POC diagnostics. The final mapping and linkage of the relevant themes, TDF constructs, and intervention types, behaviour change techniques, and implementation strategies based can be found in Table 3.

Table 3
Suggested interventions and descriptions using the behaviour change technique taxonomy (BCTTv1)

Themes	TDF Constructs	Intervention type	Grouping and Behaviour change techniques	Description of intervention strategies
Limited knowledge of the SARS-CoV-2 POC testing landscape	Knowledge	Education, persuasion	Natural consequences - Information about social and environmental consequences Comparison of outcomes - Credible source	Distribute concise information with references from recognisable peer-reviewed journals summarising advantages and drawbacks of specific POC tests.
Scepticism about the insufficient evidence	Knowledge	Education, persuasion	Natural consequences - Information about social and environmental consequences Comparison of outcomes - Credible source	Provide evidence-based information to cultivate confidence in the quality of POC tests.
Professional education and training	Skills	Training	Shaping Knowledge - Instructions on how to perform the behaviour Feedback and monitoring - Feedback on behaviour	Deliver specialised team training courses with supervision to ensure quality control of use. Ensure consistency in use. Tailor courses for healthcare assistants. Provide supervision and feedback to ensure proper device use.
PCPs would adopt POC tests if prescribed by authorities	Behavioural regulation	Enablement	Goals and planning - Action planning - Goal (Outcome)	Plan and prepare resources to implement new guidelines.

Themes	TDF Constructs	Intervention type	Grouping and Behaviour change techniques	Description of intervention strategies
Financial incentives	Environmental context and resources	Incentivisation	Reward and threat - Material incentive Goal and planning - Behavioural contract	Contractual agreements between primary care practices and the authorities to provide payment to primary care practices to run the tests.
Limited workload capacity	Environmental context and resources	Enablement	Reward and threat - Reward (outcome) - Non-specific reward Goals and planning - Problem solving Natural consequences - Information about social and environmental consequences	Provision of funding resources to increase staffing. Reduce or redistribute workload. Government funding needs to be allocated to primary care practices to increase staffing numbers.
Information sharing across practices	Social influences	Education	Natural consequences - Information about social and environmental consequences Comparison of behaviour - Information about others' approval Comparison of outcomes - Credible source	Increase PCPs knowledgebase through the provision of evidence-based information. Equip PCPs with information to assess the quality of information shared across social network groups.

Themes	TDF Constructs	Intervention type	Grouping and Behaviour change techniques	Description of intervention strategies
Society will view primary care as an alternative to community testing centres	Professional role and identity	Restriction, Persuasion	Associations - Prompts/cues Natural consequences - Information about social and environmental consequences	Public health messaging to discourage the general public from associating primary care practices as testing sites.
Perception of risk	Beliefs about consequences	Restriction, Environmental restructuring, Persuasion	Antecedents - Avoidance/reducing exposure to cues for the behaviour Natural consequences - Information about health consequences Reward and threat - Reward (outcome) - Non-specific reward	Equip primary care practices with adequate PPE supplies. Provide policies that will financially compensate primary care practice staff for the time they have to self-isolate.

Discussion

This is, to our knowledge, the first study that utilised a theoretical and methodological framework of behavioural science to specify key intervention components to guide the implementation of SARS-CoV-2 POC testing into primary care. In doing so, this study addresses a clear evidence-practice gap at the intersection of behavioural science and diagnostics. Importantly, it follows a systematic process consistent with recommendations of the Medical Research Council required for complex intervention development. By using the BCW framework, our study unpacked a broad range of social and contextual factors underlying PCPs willingness and ability to implement POC testing into routine care. Specifically, we identified key barriers/enablers and specific behaviour change techniques that allows for the ability to tailor interventions and may inform POC implementation strategies that meet the needs of a desired user. We discuss this in the following paragraphs.

First, there is a need to minimise the knowledge gap around the clinical utility of SARS-CoV-2 POC testing. Limited evidence can postulate ambiguity around the clinical benefits of POC tests and foster

uncertainties (68–70). These factors are consequential given that uncertainty arises from knowledge gaps (69, 70), and perceptions of uncertainty influence decisions and behaviours (71, 72). Cultivating trust can reduce uncertainty (73), where clinical evidence can generate trustworthiness (74, 75). Here, educational interventions can aid PCPs better evaluate the clinical utility of POC tests as information is a key mechanism for adoption if it is perceived as useful (76, 77). Information originating from credible sources can effectively persuade individuals and change attitudes (78–81), fosters positive attitudes (82), and affect cognitive and affective responses with regards to the acceptance of new innovations (83, 84). Thus, to foster positive beliefs towards POC testing, it will be critical that information disseminated to PCPs is based on evidence from reputable scientific sources.

Second, PCPs expressed the need for professional training and education to ensure that their staff are equipped with the skills necessary to deliver the tests efficiently and confidently. This belief is consistent with studies that found that education and training can change staff attitudes and improve clinical practice (85, 86). Educational interventions would be an acceptable solution, given that physicians view continuing professional development as an important component in their career (87). However, there may be some challenges as physicians have also struggled with having the time and opportunity to participate in structured education programmes (88). Strategies to deliver POC training may require close supervision, especially since an earlier assessment of a wide used POC test in the UK demonstrated a significant drop in sensitivity when used by healthcare-workers outside controlled laboratory settings (89).

Alternatively, there was a broad consensus that health care assistants (HCAs) would be the best fit to operate the tests. HCAs are already accustomed to taking on responsibilities that remove excessive burdens from GPs and nurses (90, 91), and they may be willing to accept the new role within a practice as a result of normative influences to perform the behaviour (92). Educational interventions will require the development of a standardised national training course to ensure that HCAs acquire the appropriate skills and supervision to administer the tests (93, 94).

Third, primary care practices would implement POC testing if it were issued as part of the guidelines prescribed by authoritative bodies. PCPs willingness to accept new regulations echoes similar findings in studies within the domain of normative social influence, which suggests that individuals tend to conform to authorities to receive rewards and avoid punishment (95).

Fourth, PCPs anticipated that implementing POC tests would threaten the sustainability of primary care if funding were not made available to accommodate the changes. Intervention strategies to address this barrier requires funding to support the hiring of new staff to take on roles that have traditionally been in the domain of physicians. For instance, physician assistants (associates) can reduce some of the PCPs clinical duties at an overall lower cost (96–98). Also, integrating monetary awards into pay-for-performance schemes could change PCPs perspectives to perform testing as financial incentives can induce behaviour change (99, 100). Some caution may be needed as prior research has highlighted the

risks of unintended negative consequences that divert other care efforts to reach financial targets (101–103).

Fifth, PCPs mentioned the different forms of information-sharing between colleagues influenced their perceptions of POC tests. This suggests that 'informational social influence', defined as the "influence to accept information obtained from another as evidence about reality" (104), plays a prominent role in PCPs beliefs and attitudes as they are influenced by the information exchanged within their professional network (92). For instance, studies have shown that people tend to accept others' opinion as valid information (105, 106), suggesting that PCPs attitudes towards POC tests may be dependent on the experiences of colleagues. Normative social influence could inherently affect PCPs willingness to align their thinking to that of others with regards to the benefits (or drawbacks) of POC testing (84). Intervention strategies could focus on improving the quality of evidence shared across these networks and social media platforms as source credibility elicits attitude change (107, 108).

Sixth, PCPs were concerned that their identity as care providers would be undermined if society began viewing primary care as an alternative to community testing services. PCPs already feel that primary care is not as well respected (109), and societal changes in expectations can negatively affect job satisfaction, fuel work-related stress, and threaten retention (110, 111). Intervention strategies to address these barriers would require supporting PCPs maintain their identity by developing public health messages and a testing eligibility criterion that establish boundaries for appointment requests. Such approaches would simultaneously address PCPs worries of POC testing adding to the challenges of their existing workloads (112–114).

Finally, PCPs believed the benefits of POC tests were their ability to remove clinical uncertainties between respiratory illnesses to rule-in/rule-out infectious individuals. This would generate confidence in terms of PCPs engaging in more face-to-face consultations. Yet, they equally expressed concerns that the increased contact with patients significantly increases the chance of illness transmission and the need to quarantine. The increased likelihood of exposure to SARS-CoV-2 is known to increase stress and anxiety (115–117), and can be financially devastating to practices (118). Intervention strategies to address this will require the adequate supplies of protective equipment are provided to all frontline staff members, and policies to support PCPs financially in the event they have to self-isolate (119).

This study highlights the importance of using a theoretical framework to understand the complexities of implementation and behaviour change in connection with POC testing. Using a framework ensured that we used a standardized language of theoretical constructs to theoretically diagnose implementation challenges and inform intervention developments grounded in the collective experiences and views of PCPs working in diverse regions during the pandemic. Consequently, it demonstrates that using the BCW has several strengths as it enhances our understanding and generalisability of the barriers/enablers to implementing new diagnostic tools into primary care. This allowed us to conduct a comprehensive theory-informed assessment of barriers/enablers to POC implementation and identify what needs to change to facilitate the integration of SARS-CoV-2 testing into routine care practice. Specifically, it helps

identify the target behaviours to address to ensure that implementation strategies are contextually appropriate and aligned with the experiences of PCPs and accounts of their behaviours, which increases the likelihood of acceptability. Importantly, this approach makes explicit the underlying factors influencing how intervention strategies are meant to work and the impact it is expected to have on primary care are both evidence- and theory-based.

Limitations

A limitation to this work is that it was predominately based on the perspectives of PCPs and did not include a larger sample of other patient-facing professionals. The inclusion of the perspectives of other patient-facing professionals in future studies would be valuable. This study was also conducted across 21 primary care practices in three regions in England, and therefore transferability may be limited. Another limitation is that data was originally collected between September 2020 and October prior to the second national lockdown in November 2020. It is possible some participants may have changed their perspectives on testing and priorities. It is worthy to note that the multistep process of the BCW was lengthy and time-consuming process. Application of the TDF resulted in some limitations as some codes were difficult to assign to one specific domain. Participants in this study were presented with hypothetical scenarios and with no experience of using a SARS-CoV-2 test. Their opinion might change in the event they gain such experience. Finally, while the findings provide us with insight into implementation barriers/enablers and suggested potential intervention strategies, it is not possible to comment on how successful our findings would be when translated into real-world settings. Further refinement of the interventions proposed in this study will need to undergo feasibility and pilot testing.

Conclusions

In this study, we identified barriers and enablers in the uptake of POC tests for SARS-CoV-2 in the primary care pathway. Our findings suggest that there are a broad number of interdependent barriers and enablers at the clinician-, organizational-, and system-level. Interventions to address the barriers should involve improving PCPs knowledgebase of high-quality studies demonstrating the clinical utility of POC tests, to incentivise testing, introduce policies to help embed testing into practice, and providing resources to primary care practices to meet the anticipated demands of testing. The findings of this study can be used to help inform policy makers and decision-makers improve testing dissemination strategies.

Abbreviations

behaviour change technique taxonomy version 1 (BCTTv1); clinical commissioning group (CCG); capability, opportunity and motivation-behaviour (COM-B); Coronavirus Disease 2019 (COVID-19); primary care practitioner (PCP); Health care assistant (HCA); Local Clinical Research Network (LCRN); Local Medical Committees (LMC); Medical Research Council (MRC); National Institute of Health Research (NIHR); point-of-care (POC); theoretical domains framework (TDF); Quality and Outcomes Framework (QOF); Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)

Declarations

Availability of data and materials: The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

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Ethics: The project was originally approved and registered as a service evaluation by the Newcastle Joint Research Office and recorded on the Newcastle upon Tyne Hospital Foundation Trust's Clinical Effectiveness Register (Project no. 10222). Subsequently, the Newcastle University Faculty of Medical Sciences Research Ethics Committee reviewed the protocol and deemed the work exempt from ethical approval. Participants received an information sheet and were offered the opportunity to discuss the study prior to giving informed written consent for their views and audio to be recorded and included in this study prior to the interviews taking place.

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References

1. Majeed A, Maile EJ, Bindman AB. The primary care response to COVID-19 in England's National Health Service. Journal of the Royal Society of Medicine. 2020;113(6):208-10.
2. Marshall M, Howe A, Howsam G, Mulholland M, Leach J. COVID-19: a danger and an opportunity for the future of general practice. British Journal of General Practice. 2020;70(695):270-1.
3. Mann DM, Chen J, Chunara R, Testa PA, Nov O. COVID-19 transforms health care through telemedicine: Evidence from the field. Journal of the American Medical Informatics Association. 2020;27(7):1132-5.
4. Smith AC, Thomas E, Snoswell CL, Haydon H, Mehrotra A, Clemensen J, et al. Telehealth for global emergencies: Implications for coronavirus disease 2019 (COVID-19). Journal of telemedicine and telecare. 2020;26(5):309-13.
5. Greenhalgh T, Wherton J, Shaw S, Morrison C. Video consultations for covid-19. BMJ. 2020;368:m998.
6. Gomez T, Anaya YB, Shih KJ, Tarn DM. A Qualitative Study of Primary Care Physicians' Experiences With Telemedicine During COVID-19. The Journal of the American Board of Family Medicine. 2021;34(Supplement):S61-S70.
7. Murphy M, Scott LJ, Salisbury C, Turner A, Scott A, Denholm R, et al. Implementation of remote consulting in UK primary care following the COVID-19 pandemic: a mixed-methods longitudinal

study. British Journal of General Practice. 2021;71(704):e166-e77.
8. Sotomayor-Castillo C, Nahidi S, Li C, Hespe C, Burns PL, Shaban RZ. General practitioners' knowledge, preparedness, and experiences of managing COVID-19 in Australia. Infection, Disease & Health. 2021.
9. Salisbury C, Murphy M, Duncan P. The Impact of Digital-First Consultations on Workload in General Practice: Modeling Study. J Med Internet Res. 2020;22(6):e18203.
10. Gray R, Sanders C. A reflection on the impact of COVID-19 on primary care in the United Kingdom. Journal of Interprofessional Care. 2020;34(5):672-8.
11. Rodriguez JA, Betancourt JR, Sequist TD, Ganguli I. Differences in the use of telephone and video telemedicine visits during the COVID-19 pandemic. Am J Manag Care. 2021;27(1):21-6.
12. Dinnes J, Deeks JJ, Adriano A, Berhane S, Davenport C, Dittrich S, et al. Rapid, point-of-care antigen and molecular-based tests for diagnosis of SARS-CoV-2 infection. Cochrane Database of Systematic Reviews. 2020(8).
13. Mina MJ, Andersen KG. COVID-19 testing: One size does not fit all. Science. 2021;371(6525):126-7.
14. Schols AM, Dinant G-J, Hopstaken R, Price CP, Kusters R, Cals JW. International definition of a point-of-care test in family practice: a modified e-Delphi procedure. Family practice. 2018;35(4):475-80.
15. Su Z, Wen J, McDonnell D, Goh E, Li X, Šegalo S, et al. Vaccines are not yet a silver bullet: The imperative of continued communication about the importance of COVID-19 safety measures. Brain, Behavior, & Immunity - Health. 2021;12:100204.
16. Gómez CE, Perdiguero B, Esteban M. Emerging SARS-CoV-2 Variants and Impact in Global Vaccination Programs against SARS-CoV-2/COVID-19. Vaccines. 2021;9(3).
17. Walensky RP, Walke HT, Fauci AS. SARS-CoV-2 Variants of Concern in the United States—Challenges and Opportunities. JAMA. 2021;325(11):1037-8.
18. Razai MS, Osama T, McKechnie DG, Majeed A. Covid-19 vaccine hesitancy among ethnic minority groups. British Medical Journal Publishing Group; 2021.
19. Su Z, Wen J, Abbas J, McDonnell D, Cheshmehzangi A, Li X, et al. A race for a better understanding of COVID-19 vaccine non-adopters. Brain, behavior, & immunity-health. 2020:100159.
20. Paltiel AD, Zheng A, Sax PE. Clinical and Economic Effects of Widespread Rapid Testing to Decrease SARS-CoV-2 Transmission. Annals of Internal Medicine. 2021.
21. Foy R, Eccles M, Grimshaw J. Why does primary care need more implementation research? : Oxford University Press; 2001.
22. Eccles MP, Armstrong D, Baker R, Cleary K, Davies H, Davies S, et al. An implementation research agenda. BioMed Central; 2009.
23. Hollnagel E. Why is work-as-imagined different from work-as-done? Resilient Health Care: The resilience of everyday clinical work: Ashgate; 2015. p. 249-64.
24. Blandford A, Furniss D, Vincent C. Patient safety and interactive medical devices: Realigning work as imagined and work as done. Clinical Risk. 2014;20(5):107-10.

25. Michie S, Johnston M, Francis J, Hardeman W, Eccles M. From theory to intervention: mapping theoretically derived behavioural determinants to behaviour change techniques. Applied psychology. 2008;57(4):660-80.
26. Nilsen P. Making sense of implementation theories, models, and frameworks. Implementation Science 30: Springer; 2020. p. 53-79.
27. Baker R, Camosso-Stefinovic J, Gillies C, Shaw EJ, Cheater F, Flottorp S, et al. Tailored interventions to overcome identified barriers to change: effects on professional practice and health care outcomes. Cochrane Database of Systematic Reviews. 2010(3).
28. Improved Clinical Effectiveness through Behavioural Research G. Designing theoretically-informed implementation interventions. Implement Sci. 2006;1:4-.
29. Chalmers I, Glasziou P. Avoidable waste in the production and reporting of research evidence. The Lancet. 2009;374(9683):86-9.
30. Sharp CA, Swaithes L, Ellis B, Dziedzic K, Walsh N. Implementation research: making better use of evidence to improve healthcare. Rheumatology. 2020;59(8):1799-801.
31. Michie S, Johnston M, Abraham C, Lawton R, Parker D, Walker A. Making psychological theory useful for implementing evidence based practice: a consensus approach. BMJ Quality & Safety. 2005;14(1):26-33.
32. Michie S, West R, Campbell R, Brown J, Gainforth H. ABC of behaviour change theories: Silverback publishing; 2014.
33. Craig P, Dieppe P, Macintyre S, Michie S, Nazareth I, Petticrew M. Developing and evaluating complex interventions: the new Medical Research Council guidance. Bmj. 2008;337.
34. Michie S, Van Stralen MM, West R. The behaviour change wheel: a new method for characterising and designing behaviour change interventions. Implementation science. 2011;6(1):1-12.
35. Atkins L, Francis J, Islam R, O'Connor D, Patey A, Ivers N, et al. A guide to using the Theoretical Domains Framework of behaviour change to investigate implementation problems. Implementation Science. 2017;12(1):1-18.
36. Michie S, Richardson M, Johnston M, Abraham C, Francis J, Hardeman W, et al. The behavior change technique taxonomy (v1) of 93 hierarchically clustered techniques: building an international consensus for the reporting of behavior change interventions. Annals of behavioral medicine. 2013;46(1):81-95.
37. Cane J, O'Connor D, Michie S. Validation of the theoretical domains framework for use in behaviour change and implementation research. Implementation science. 2012;7(1):1-17.
38. Michie S, Atkins L, West R. The behaviour change wheel. A guide to designing interventions 1st ed Great Britain: Silverback Publishing. 2014:1003-10.
39. French SD, McKenzie JE, O'Connor DA, Grimshaw JM, Mortimer D, Francis JJ, et al. Evaluation of a theory-informed implementation intervention for the management of acute low back pain in general medical practice: the IMPLEMENT cluster randomised trial. PloS one. 2013;8(6):e65471.

40. Murphy K, O'Connor DA, Browning CJ, French SD, Michie S, Francis JJ, et al. Understanding diagnosis and management of dementia and guideline implementation in general practice: a qualitative study using the theoretical domains framework. Implementation Science. 2014;9(1):1-13.
41. Kirk JW, Sivertsen DM, Petersen J, Nilsen P, Petersen HV. Barriers and facilitators for implementing a new screening tool in an emergency department: A qualitative study applying the Theoretical Domains Framework. Journal of clinical nursing. 2016;25(19-20):2786-97.
42. Phillips CJ, Marshall AP, Chaves NJ, Jankelowitz SK, Lin IB, Loy CT, et al. Experiences of using the Theoretical Domains Framework across diverse clinical environments: a qualitative study. Journal of multidisciplinary healthcare. 2015;8:139.
43. Lawton R, Heyhoe J, Louch G, Ingleson E, Glidewell L, Willis TA, et al. Using the theoretical domains framework (TDF) to understand adherence to multiple evidence-based indicators in primary care: a qualitative study. Implementation science. 2015;11(1):1-16.
44. Yamada J, Potestio ML, Cave AJ, Sharpe H, Johnson DW, Patey AM, et al. Using the theoretical domains framework to identify barriers and enablers to pediatric asthma management in primary care settings. Journal of Asthma. 2018;55(11):1223-36.
45. Cane J, Richardson M, Johnston M, Ladha R, Michie S. From lists of behaviour change techniques (BCT s) to structured hierarchies: comparison of two methods of developing a hierarchy of BCT s. British journal of health psychology. 2015;20(1):130-50.
46. Abraham C, Michie S. A taxonomy of behavior change techniques used in interventions. Health psychology. 2008;27(3):379.
47. French SD, Green SE, O'Connor DA, McKenzie JE, Francis JJ, Michie S, et al. Developing theory-informed behaviour change interventions to implement evidence into practice: a systematic approach using the Theoretical Domains Framework. Implementation Science. 2012;7(1):1-8.
48. Connell LA, McMahon NE, Redfern J, Watkins CL, Eng JJ. Development of a behaviour change intervention to increase upper limb exercise in stroke rehabilitation. Implementation science. 2015;10(1):1-9.
49. Sinnott C, Mercer SW, Payne RA, Duerden M, Bradley CP, Byrne M. Improving medication management in multimorbidity: development of the MultimorbiditY COllaborative Medication Review And DEcision making (MY COMRADE) intervention using the Behaviour Change Wheel. Implementation Science. 2015;10(1):1-11.
50. Bowling A. Research methods in health: investigating health and health services: McGraw-hill education (UK); 2014.
51. Kierkegaard P, Hicks T, Yang Y, Lee J, Hayward G, Turner PJ, et al. Primary care and point-of-care testing during a pandemic: Clinician's perspectives on integrating rapid testing for COVID-19 into the primary care pathway. medRxiv. 2021:2021.04.13.21255347.
52. Heaton J. Secondary analysis of qualitative data: An overview. Historical Social Research/Historische Sozialforschung. 2008:33-45.

53. Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. International journal for quality in health care. 2007;19(6):349-57.
54. Francis JJ, Johnston M, Robertson C, Glidewell L, Entwistle V, Eccles MP, et al. What is an adequate sample size? Operationalising data saturation for theory-based interview studies. Psychology and health. 2010;25(10):1229-45.
55. Guest G, Bunce A, Johnson L. How many interviews are enough? An experiment with data saturation and variability. Field methods. 2006;18(1):59-82.
56. Braun V, Clarke V. Using thematic analysis in psychology. Qualitative research in psychology. 2006;3(2):77-101.
57. Glaser BG, Strauss AL. Discovery of grounded theory: Strategies for qualitative research: Routledge; 2017.
58. Hayes D, Edbrooke-Childs J, Town R, Wolpert M, Midgley N. Barriers and facilitators to shared decision making in child and youth mental health: clinician perspectives using the theoretical domains framework. European child & adolescent psychiatry. 2019;28(5):655-66.
59. Murphy AL, Gardner DM, Kutcher SP, Martin-Misener R. A theory-informed approach to mental health care capacity building for pharmacists. International journal of mental health systems. 2014;8(1):1-11.
60. Alexander KE, Brijnath B, Mazza D. Barriers and enablers to delivery of the Healthy Kids Check: an analysis informed by the Theoretical Domains Framework and COM-B model. Implementation Science. 2014;9(1):1-14.
61. Hicks T, Winter A, Green K, Kierkegaard P, Price D, Body R, et al. Care Pathway And Prioritization Of Rapid Testing For Covid-19 In UK Hospitals: A Qualitative Evaluation. 2020.
62. Kierkegaard P, McLister A, Buckle P. Rapid point-of-care testing for COVID-19: quality of supportive information for lateral flow serology assays. BMJ Open. 2021;11(3):e047163.
63. Micocci M, Gordon AL, Allen AJ, Hicks T, Kierkegaard P, McLister A, et al. COVID-19 testing in English care homes and implications for staff and residents. Age Ageing. 2021:afab015.
64. Lau R, Stevenson F, Ong BN, Dziedzic K, Treweek S, Eldridge S, et al. Achieving change in primary care—effectiveness of strategies for improving implementation of complex interventions: systematic review of reviews. BMJ open. 2015;5(12):e009993.
65. Ben Charif A, Zomahoun HTV, LeBlanc A, Langlois L, Wolfenden L, Yoong SL, et al. Effective strategies for scaling up evidence-based practices in primary care: a systematic review. Implementation Science. 2017;12(1):139.
66. Armstrong N, Herbert G, Brewster L. Contextual barriers to implementation in primary care: an ethnographic study of a programme to improve chronic kidney disease care. Family Practice. 2016;33(4):426-31.
67. Creswell JW, Miller DL. Determining validity in qualitative inquiry. Theory into practice. 2000;39(3):124-30.

68. Elster J. Explaining social behavior: More nuts and bolts for the social sciences: Cambridge University Press; 2015.
69. Giddens A. The consequences of modernity: John Wiley & Sons; 2013.
70. Luhmann N. Trust and power: John Wiley & Sons; 2018.
71. Zinn JO. Social theories of risk and uncertainty: An introduction: John Wiley & Sons; 2009.
72. Frederiksen M. Trust in the face of uncertainty: a qualitative study of intersubjective trust and risk. International Review of Sociology. 2014;24(1):130-44.
73. Heimer CA. Solving the problem of trust: American Bar Foundation; 1999.
74. Butler CC, Simpson S, Wood F. General practitioners' perceptions of introducing near-patient testing for common infections into routine primary care: a qualitative study. Scand J Prim Health Care. 2008;26(1):17-21.
75. Li X, Hess TJ, Valacich JS. Why do we trust new technology? A study of initial trust formation with organizational information systems. The Journal of Strategic Information Systems. 2008;17(1):39-71.
76. Satzinger JW, Olfman L. Computer Support for Group Work: Perceptions of the Usefulness of Support Scenarios and End-User Tools. Journal of Management Information Systems. 1995;11(4):115-48.
77. Sussman SW, Siegal WS. Informational Influence in Organizations: An Integrated Approach to Knowledge Adoption. Information Systems Research. 2003;14(1):47-65.
78. Ziegler R. Mood, source characteristics, and message processing: A mood-congruent expectancies approach. Journal of Experimental Social Psychology. 2010;46(5):743-52.
79. McGinnies E, Ward CD. Better Liked than Right:Trustworthiness and Expertise as Factors in Credibility. Personality and Social Psychology Bulletin. 1980;6(3):467-72.
80. Tormala ZL, Briñol P, Petty RE. Multiple Roles for Source Credibility Under High Elaboration: It's all in the Timing. Social Cognition. 2007;25(4):536-52.
81. Pornpitakpan C. The Persuasiveness of Source Credibility: A Critical Review of Five Decades' Evidence. Journal of Applied Social Psychology. 2004;34(2):243-81.
82. HOVLAND CI, WEISS W. The Influence of Source Credibility on Communication Effectiveness*. Public Opinion Quarterly. 1951;15(4):635-50.
83. Hocevar KP, Metzger M, Flanagin AJ. Source credibility, expertise, and trust in health and risk messaging. Oxford Research Encyclopedia of Communication2017.
84. Li C-Y. Persuasive messages on information system acceptance: A theoretical extension of elaboration likelihood model and social influence theory. Computers in Human Behavior. 2013;29(1):264-75.
85. Marinopoulos SS, Dorman T, Ratanawongsa N, Wilson LM, Ashar BH, Magaziner JL, et al. Effectiveness of continuing medical education. Evid Rep Technol Assess (Full Rep). 2007(149):1-69.

86. O'Brien MA, Freemantle N, Oxman AD, Wolfe F, Davis D, Herrin J. Continuing education meetings and workshops: effects on professional practice and health care outcomes. Cochrane Database of Systematic Reviews. 2001(1).
87. Campion-Smith C, Smith H, White P, Baker E, Baker R, Holloway I. Learners' experience of continuing medical education events: a qualitative study of GP principals in Dorset. British Journal of General Practice. 1998;48(434):1590-3.
88. VanNieuwenborg L, Goossens M, De Lepeleire J, Schoenmakers B. Continuing medical education for general practitioners: a practice format. Postgraduate Medical Journal. 2016;92(1086):217-22.
89. Deeks JJ, Raffle AE. Lateral flow tests cannot rule out SARS-CoV-2 infection. BMJ. 2020;371:m4787.
90. Vail L, Bosley S, Petrova M, Dale J. Healthcare assistants in general practice: a qualitative study of their experiences. Primary Health Care Research & Development. 2011;12(1):29-41.
91. Petrova M, Vail L, Bosley S, Dale J. Benefits and challenges of employing health care assistants in general practice: a qualitative study of GPs' and practice nurses' perspectives. Family Practice. 2010;27(3):303-11.
92. Kaplan MF, Miller CE. Group decision making and normative versus informational influence: Effects of type of issue and assigned decision rule. Journal of Personality and social psychology. 1987;53(2):306.
93. Kantaris X, Radcliffe M, Acott K, Hughes P, Chambers M. Training healthcare assistants working in adult acute inpatient wards in Psychological First Aid: An implementation and evaluation study. Journal of Psychiatric and Mental Health Nursing. 2020;27(6):742-51.
94. Keeney S, Hasson F, McKenna HP. Healthcare assistants' experiences and perceptions of participating in a training course. Learning in Health and Social Care. 2005;4(2):78-88.
95. Higgins MC. Follow the leader? The effects of social influence on employer choice. Group & Organization Management. 2001;26(3):255-82.
96. Drennan VM, Halter M, Joly L, Gage H, Grant RL, Gabe J, et al. Physician associates and GPs in primary care: a comparison. British Journal of General Practice. 2015;65(634):e344-e50.
97. Curran A, Parle J. Physician associates in general practice: what is their role? British Journal of General Practice. 2018;68(672):310-1.
98. Kierkegaard P, Vale MD, Garrison S, Hollenbeck BK, Hollingsworth JM, Owen-Smith J. Mechanisms of decision-making in preoperative assessment for older adult prostate cancer patients—A qualitative study. Journal of Surgical Oncology. 2020;121(3):561-9.
99. Torchiana DF, Colton DG, Rao SK, Lenz SK, Meyer GS, Ferris TG. Massachusetts General Physicians Organization's quality incentive program produces encouraging results. Health Affairs. 2013;32(10):1748-56.
100. Khullar D, Chokshi DA, Kocher R, Reddy A, Basu K, Conway PH, et al. Behavioral economics and physician compensation—promise and challenges. New England Journal of Medicine. 2015;372(24):2281-3.

101. Sutton M, Elder R, Guthrie B, Watt G. Record rewards: the effects of targeted quality incentives on the recording of risk factors by primary care providers. Health Economics. 2010;19(1):1-13.
102. Allen T, Mason T, Whittaker W. Impacts of pay for performance on the quality of primary care. Risk Manag Healthc Policy. 2014;7:113-20.
103. Glasziou PP, Buchan H, Del Mar C, Doust J, Harris M, Knight R, et al. When financial incentives do more good than harm: a checklist. BMJ : British Medical Journal. 2012;345:e5047.
104. Deutsch M, Gerard HB. A study of normative and informational social influences upon individual judgment. The journal of abnormal and social psychology. 1955;51(3):629.
105. Aronson E, Akert RM, Wilson TD. Sozialpsychologie: Pearson Deutschland GmbH; 2010.
106. Price V, Nir L, Cappella JN. Normative and informational influences in online political discussions. Communication Theory. 2006;16(1):47-74.
107. Tormala ZL, Briñol P, Petty RE. When credibility attacks: The reverse impact of source credibility on persuasion. Journal of Experimental Social Psychology. 2006;42(5):684-91.
108. O'keefe DJ. Persuasion: Theory and research: Sage Publications; 2015.
109. Elvey R, Voorhees J, Bailey S, Burns T, Hodgson D. GPs' views of health policy changes: a qualitative 'netnography' study of UK general practice online magazine commentary. British Journal of General Practice. 2018;68(671):e441-e8.
110. Buchbinder SB, Wilson M, Melick CF, Powe NR. Primary care physician job satisfaction and turnover. American Journal of Managed Care. 2001;7(7):701-16.
111. Marchand C, Peckham S. Addressing the crisis of GP recruitment and retention: a systematic review. British Journal of General Practice. 2017;67(657):e227-e37.
112. Croxson CH, Ashdown HF, Hobbs FR. GPs' perceptions of workload in England: a qualitative interview study. British Journal of General Practice. 2017;67(655):e138-e47.
113. Hobbs FDR, Bankhead C, Mukhtar T, Stevens S, Perera-Salazar R, Holt T, et al. Clinical workload in UK primary care: a retrospective analysis of 100 million consultations in England, 2007–14. The Lancet. 2016;387(10035):2323-30.
114. Trivedi N, Trivedi V, Moorthy A, Trivedi H. Recovery, restoration, and risk: a cross-sectional survey of the impact of COVID-19 on GPs in the first UK city to lock down. BJGP Open. 2020:BJGPO.2020.0151.
115. Simione L, Gnagnarella C. Differences between health workers and general population in risk perception, behaviors, and psychological distress related to COVID-19 spread in Italy. 2020.
116. Wu Y, Wang J, Luo C, Hu S, Lin X, Anderson AE, et al. A comparison of burnout frequency among oncology physicians and nurses working on the front lines and usual wards during the COVID-19 epidemic in Wuhan, China. Journal of pain and symptom management. 2020.
117. Cai H, Tu B, Ma J, Chen L, Fu L, Jiang Y, et al. Psychological Impact and Coping Strategies of Frontline Medical Staff in Hunan Between January and March 2020 During the Outbreak of Coronavirus Disease 2019 (COVID-19) in Hubei, China. Med Sci Monit. 2020;26:e924171-e.

118. Basu S, Phillips RS, Phillips R, Peterson LE, Landon BE. Primary Care Practice Finances In The United States Amid The COVID-19 Pandemic. Health Affairs. 2020;39(9):1605-14.
119. Lau J, Tan DH-Y, Wong GJ, Lew Y-J, Chua Y-X, Low L-L, et al. The impact of COVID-19 on private and public primary care physicians: A cross-sectional study. Journal of Infection and Public Health. 2021.

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