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Title

Investigating primary health care practitioners' barriers and enablers to referral of COPD patients to Pulmonary Rehabilitation: an exploratory sequential mixed methods study using the Theoretical Domains Framework.

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Key words

Chronic Obstructive Pulmonary Disease (COPD), Pulmonary Rehabilitation (PR), Primary Care, Theoretical Domains Framework (TDF). Mixed methods research.

List of Abbreviations

PR – Pulmonary Rehabilitation
COPD – Chronic Obstructive Pulmonary Disease
PHCP – Primary Health Care Practitioner
TDF – Theoretical Domains Framework

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Abstract

Objectives
Pulmonary rehabilitation is a highly effective, recommended intervention for patients with COPD. Using behavioural theory to understand why referral remains low enables the development of targeted interventions in order to improve future PR referral.

Methods
We undertook an exploratory sequential mixed methods study to investigate referral practices of Primary Health Care Practitioners (PHCPs) in the United Kingdom (UK). In phase 1 semi-structured interviews were undertaken. Content analysis was used to map themes to the Theoretical Domains Framework (TDF) and a 54-item TDF based questionnaire was developed.

In Phase 2 we distributed the questionnaire to a larger PHCP population. We used descriptive analyses to identify barriers and enablers, and key TDF domains. Mixing of data occurred at 2 points; instrument design and interpretation.

Results

19 PHCP took part in interviews and 233 responded to the survey. Integrated results revealed that PHCPs with a post qualifying respiratory qualification (154/241; 63.9%) referred more frequently (91/154; 59.1%) than those without (28/87; 32.2%).

There were more barriers than enablers for referral in all 13 TDF domains. Key barriers included: infrequent engagement from PR provider to referrer, concern around patient's physical ability and access to PR (particularly for those in work), assumed poor patient motivation, no clear practice referrer and few referral opportunities. These mapped to domains: belief about capabilities, social influences, environment, optimism, skills and social and professional role.

Enablers to referral were observed in knowledge, social influences memory and environment domains. Many PHCPs believed in the physical and psychological value of PR. Helpful enablers were out-of-practice support from respiratory interested colleagues, dedicated referral time (annual review) and on-screen referral prompts.

Conclusions

Referral to PR is complex. Barriers outweighed enablers. Aligning these findings to behaviour change techniques will identify interventions to overcome barriers and strengthen enablers, thereby increasing referral of COPD patients to PR.

Strengths and limitations of this study

1: This is the first mixed methods study to use the Theoretical Domains Framework to identify barriers and enablers to pulmonary rehabilitation referral from a primary health care practitioner perspective.

2: The utilisation and combination of two differing research paradigms in this exploratory sequential approach offers novel and detailed insights through combined research lenses which encompass multiple perspectives.

3: Many geographical regions across the United Kingdom are represented and include a diverse range of primary healthcare practitioners.

4: A combination of participant recruitment approaches have been used to reduce potential sample and selection biases.

5: Generalisability of the overall findings are limited by the inability to calculate distribution and therefore response rates.

Background

Pulmonary Rehabilitation (PR) is a low cost, high value, internationally recommended intervention for COPD patients which is effective in improving exercise capacity, reducing the impact of symptoms and improving prognosis (1) (1) (2) (3) (4). It is a structured multidisciplinary intervention combining individualised exercise with disease-related education (4). Despite the clear evidence of its effectiveness, the proportion of COPD patients receiving PR is persistently low worldwide (5) (6). Our previously published inductive qualitative paper presented the experiences of primary health care practitioners (PHCPs) as key potential referrers to PR (7). We found that there was a generalised awareness of PR, but little detailed knowledge of either the programme or the clinical benefits. Relationships with PR providers were limited, but considered important. Patient characteristics, rather than clinical need, influenced referral offers and referrers frequently believed patients to be poorly motivated. PR was most commonly offered during times of disease stability (usually at COPD annual review) and ease of the referral process and financial incentives positively influenced referral. In summary, referrers reported many barriers but few enablers, which collectively resulted in infrequent discussions about PR and associated referrals.

However, in order to aid the development of appropriate interventions to improve referral rates it is important to establish the generalisability and relative importance of these findings within a broader population of PHCPs. Furthermore, applying theory to identify the psychological and structural drivers that influence behaviour (8, 9) may offer new insights to shape interventions (10).

The Theoretical Domains Framework (TDF) is a well-recognised approach which was derived from a synthesis of behaviour change theories (11, 12), and examines the processes

that influence behaviour (11). When applied, it offers explanations for behaviours, highlighting reasons that may inhibit or promote (13, 14) implementation of practice-based change (15).

Using mixed methods, and applying the TDF we sought to assess and explain the reasons for low PR referral by primary health care professionals (PHCPs) for patients with COPD. Our aim was to inform the development of theory informed interventions to improve PR referral rates from primary care in future.

Methods

We used an exploratory sequential design defined by two separate phases (figure 1). The cognitive and practical experiences of PHCP when considering and undertaking referral for patients with COPD were initially explored using a deductive approach by applying the TDF to data from our previously collected qualitative interviews. These findings informed a second quantitative phase, where we tested themes for generalisability using a nationwide survey of PHCP, to highlight the most relevant factors influencing referral. (16) (17) (18).

Figure 1 Sequential exploratory research design

Both data sets retained independent value and meaning, but were connected at two time points: 1) where the qualitative data was used to construct the questionnaire and 2) where phase 1 and 2 results were integrated to inform interpretation. The exploratory sequential mixed methods design therefore achieves both methodological and content integration (17, 18).

Patient and Public Involvement

There has been no public and/or patient involvement in this study.

Phase 1 Application of TDF to qualitative interview data.

We re-analysed data from our previously published inductive qualitative study (7) in which 19 PHCPs from two differing geographical regions across Central and East of England were recruited and interviewed to thematic saturation using a pre-designed topic guide. A deductive approach using content analysis was used for re-analysis of the data in order to align the results to the TDF and to offer new insights.

The interview topic guide (Additional file 1) was mapped to the Capability Opportunity Motivation-Behaviour model (COM-B), a model that highlights three critical prerequisites for behaviour change (19). This model was adopted rather than the TDF to guide interviews primarily because of the practical need to reduce interview length without compromising its aim. COM-B is very closely aligned to the TDF and has been utilised as a topic guide and mapped to the TDF in a similar health care professional study (20). The topic guide allowed the researcher (JW) to ensure theoretical informed components were covered including prompts allowing deeper understanding relative to the target behaviour, referral to PR. Photographic images of individuals depicting differing stages of COPD were also used to elicit associative visual responses and to enrich behavioural understanding.

Analysis

All interview transcripts were managed using NVivo v12. Barriers and enablers emerging from the interviews via content analysis were mapped to the relevant TDF domain, initially using construct labelling (11) (Additional File 2). Utterances were coded once and to only one TDF domain to reduce duplication. JW undertook the initial coding then 5 transcripts were randomly allocated and distributed throughout the team (RJ, PA, and SG) and independent TDF coding occurred, followed by collaborative team discussion to ensure agreement with the coding. Queries were discussed with a behavioural expert (IV).

Phase 2 Quantitative Methodology

Study Design – Cross sectional survey.

PHCPs were recruited via two main methods. Initially an invitation was included in a fortnightly newsletter emailed to members of the Primary Care Respiratory Society (PCRS). The survey was additionally distributed and shared by PCRS via their organisational Twitter and Facebook accounts. Social media distribution of the survey was further increased by

individual and other organisational sharing, including the Facebook accounts of Advanced Practice UK and General Practice Nurse UK. A link for questionnaire completion was provided to the platform 'Online Survey' (21). This was open between April and December 2019. To increase participation, responders were invited to opt in to a prize draw to win an I-pad.

Simultaneously, paper versions of the questionnaire were distributed at 6 UK conferences between March and November 2019 to attending PHCPs (predominately by hand by JW, and using 'in-conference bag' distribution at one event). Upon self-completion, questionnaires were placed by participants in a locked ballot box and an optional token of appreciation was offered. Paper questionnaires were manually entered onto 'Online survey' by JW.

As this was exploratory research, no *a priori* sample size calculations were performed. A pragmatic approach to study closure was adopted, this being online availability for a period of 8 months, distribution of the questionnaire at several appropriate PHCP targeted events, and that a representative range of PHCP had responded.

Methodology– Instrument Design

The cross-sectional survey (Additional file 3), collected (1) individual socio-demographic data, (2) current referral experiences, using TDF-based Likert scale questions (n=54) and (3) any new or complementary issues which may not have been previously mentioned, using an optional open question (22).

Socio-demographic data

These included questions on geographical location of practice, job title, post-qualifying respiratory education and estimated frequency of PR referrals, using questions with pre-specified options.

Psychometric data

Barriers and enablers for PR referral identified from the phase 1 qualitative findings were converted into belief statements (11), including some that sought to test direct understanding.

All questions were generated and aligned to the TDF by the coder (JW) and validated by other team coders (RJ), including a TDF expert (IV). 54 closed, fully labelled 5-point, Likert scale questions/belief statements were included with responses ranging from 'strongly disagree' to 'strongly agree' and a mid-point rating. Some statements were reversed as an opposite belief to that frequently reported in the phase 1 data. These design elements were purposely selected to improve reliability and validity (23).

The final survey mapped the 54 belief statements and open question section to 12 out of 14 theoretical domains ('emotion' and 'behavioural regulation' was excluded, given its low mapping in phase 1 results). Two rounds of survey piloting were undertaken with five practice nurses and the questionnaire refined to ensure question clarity and clearer completion instructions.

Analysis

All data were exported into an excel spreadsheet and STATAv16 used to conduct simple descriptive statistics (frequencies and percentages), dichotomising into Agree/Strongly Agree *vs* the remaining options. Free text that directly related to barriers and enablers of referral practice was content-mapped to the TDF and thematic analysis applied (24).

Results

Response rates.

Table 1 shows paper survey distribution (>1100 across 6 events) and return rates for phase 2. 154 questionnaires were returned and 134 (83%) had completed the survey sufficiently and were included. Online, it is unknown how many potential practitioners read the survey invitation, therefore participation rates could not be calculated. 123 participants started the online survey, but only 99 (80.5%) completed it and were included in the analysis.

Table 1 Paper survey distribution

Conference	Attendee number and profile	Number distributed	Number Returned

Conference 1 – GPN	Unable to obtain attendance number (Community & general practice nurses) @ 170	117	33 (28%)
Conference 2 - RCGP	141 (68 GPs inc registrars)	48	24 (50%)
Conference 3 - NIP-N	171 (Community & general practice nurses)	47	26 (55%)
Conference 4 - NIP-M*	382 (Community & general practice nurses)	382 - 400	36 (9.4-9%)
Conference 5 – NIP-C	236 (Community & general practice nurses)	51	31 (61%)
Workshop – PCRS	27 (Community & general practice nurses, 4 GP's, pharmacist x2)	8	4 (50%)
Total	@ 1,127	653-671	154 (23-23.6%)

*Surveys placed in conference bags

GPN = General Practice Nurses, RCGP = Royal College of General Practitioners, NIP = Nursing in Practice (N=Northampton, M =Manchester, C =Cardiff), PCRS = Primary Care Respiratory Society.

Description of participants

Table 2 presents the socio-demographic characteristics for all participants in the phase 1 qualitative (n=19) and phase 2 quantitative (n=233) studies.

The qualitative study included a greater proportion of GPs (6/19, 32%) compared with the survey respondents (29/233, 12.5%), who were also predominantly female, and nurses. Nurse respondents were similarly distributed across both conference and online groups (110/134, 82.1%; and 76/99, 76.9% respectively) and responders from both sources had similar time working in practice. However, respondents recruited through conferences, compared to those who responded online, tended to be younger (28% < 40 years of age), more likely to be practice nurses rather than other types of professionals, but were less likely to have respiratory qualifications, to see COPD patients or to refer them to PR.

Table 2 Baseline demographics of all participants

		Phase 1 Interviews (n=19) (%)	Phase 2 Survey (n=233) Conference (n=134) (%) (%)	Online (n=99) (%)	Total (n=233)
Primary Health Care Practitioner Role	General Practitioner (GP)	6 (32)	18 (13.4)	11 (11.1)	29 (12.5)
	Advanced Nurse Practitioner (ANP)	4 (21)	25 (18.7)	32 (32.3)	57 (24.5)
	Practice Nurse (PN)	7 (37)	85 (63.4)	44 (44.5)	129 (55.4)
	Emergency Care Practitioner (ECP)	-	1 (0.8)	1 (1)	2(0.9)
	Pharmacist	-	-	4 (4)	4 (1.7)
	Health Care Assistant (HCA)	1 (5)	-	1 (1)	1 (0.4)
	Other	1 (5)	5 (3.7)	6 (6.1)	11 (4.7))

	Total responses	19 (100)	134/134 (100)	99/99 (100)	233/233 (100)
Sex	Female	14 (74)	115 (91.3)	92 (92.9)	207 (92)
	Male	5 (26)	11 (8.7)	7 (7.1)	18 (8)
	Total responses	19	126/134 (94)	99/99 (100)	225/233 (96.6)
Age (years)	18-29	Data not	5 (3.8)	2 (2)	7 (3.0)
	30-39	collected	32 (24)	11 (11.1)	43 (18.5)
	40-49		36 (27.1)	40 (40.4)	76 (32.8)
	50-59		49 (36.8)	40 (40.4)	89 (38.4)
	60 +		11 (8.3)	6 (6.1)	17(7.3)
	Total responses		133/134 (99.3)	99/99 (100)	232/233(99.6)
Ethnicity	White British	Data not	112 (84.2)	87 (87.9)	199 (85.7)
	White other	collected	8 (6)	4 (4.1)	12 (5.2)
	Asian/Asian British		7 (5.3)	3 (3)	10 (4.3)
	Mixed Multiple Ethnic Groups		1 (0.7)	2 (2)	3 (1.3)
	Black/African/Caribbean/Black British		2 (1.4)	-	2 (0.9)
	Other ethnic group		3 (2.4)	3 (3)	6 (2.6)
	Total responses		133/134 (99.3)	99/99 (100)	232/233(99.6)
Practice Geographical Location	Scotland	-	1 (0.8)	3 (3)	4 (1.7)
	England North East and West	-	31 (23.6)	15 (15.1)	46 (20)
	Yorkshire and the Humber	-	8 (6.1)	6 (6.1)	14 (6)
	Midlands (East and West)	9 (45)	20 (15.3)	16 (16.1)	36 (15.8)
	East of England	10 (55)	23 (17.5)	18 (18.2)	41 (17.8)
	Wales	-	31 (23.6)	-	31 (13.5)
	London	-	3 (2.4)	6 (6.1)	9 (3.9)
	South (East and West)	-	14 (10.7)	35 (35.4)	49 (21.3)
	Total responses	19 (100)	131/134 (97.8)	99/99 (100)	230/233(98.7)
Years in General Practice	< 5	Data not	39 (29.9)	23 (23.2)	62 (27)
	6- 10	collected	26 (19.8)	25 (25.3)	51 (22.2)
	11-15		18 (13.7)	18 (18.2)	36 (15.7)
	16-20		22 (16.8)	14 (14.1)	36 (15.7)
	21 +		26 (19.8)	19 (19.2)	45 (19.4)
	Total responses		131/134 (97.8)	99/99 (100)	230/233(98.7)
Currently see COPD patients	Acute Management	Data not	9 (6.7)	5 (5)	14 (6)
	Chronic Management	collected	30 (22.6)	26 (26.3)	56 (24)
	Acute and Chronic management		81 (60.9)	67 (67.6)	148 (64)
	Don't see COPD patients		13 (9.8)	1 (1)	14 (6)
	Total responses		133/134 (99.3)	99/99 (100)	232/233(99.6)
CPD Respiratory Qualifications*	None	7 (36.8)	62 (46.3)	19 (19.2)	81 (34.8)
	COPD Diploma	-	28 (20.9)	50 (50.5)	78 (33.5)
	Asthma Diploma	-	38 (28.4)	52 (50.5)	90 (38.6)
	ARTP Spiro	-	34 (25.4)	40 (40.4)	74 (31.8)
	Other	12(63.2)**	16 (11.9)	26 (26.3)	42 (18)
	> one qualification	-	32 (23.9)	51 (51.5)	83 (35.6)
	Total responses	19	210	238	448
Reported PR referral practice	Yes (frequency not specified)	-	-	11 (11.1)	11 (4.7)
	Weekly	1 (5.3)	16 (12)	32 (32.3)	48 (20.7)
	Monthly	10 (52.6)	40 (30.1)	21 (21.2)	61 (26.3)
	< Monthly	9 (47.4)	43 (32.3)	29 (29.3)	72 (31)
	None	0	34 (25.6)	6 (6.1)	40 (17.3)
	Total	19	133/134 (99.3)	99/99 (100)	232/233(99.6)

Referral to PR by type of healthcare professional

Overall, 109 (49.1%) reported being frequent referrers to PR, with GPs being less likely to refer and other professions including emergency care practitioners and nurse practitioners and ANPs more likely to refer. Referral was also higher among those with one or more

continuous practice development (CPD) respiratory qualifications. However, this may be partly related to such qualification being higher among ANPs (82.5% (47/57)) and other grouped professions (58.8% (10/17)) than among GPs (17.9% (5/28)). More than 10 years spent in general practice appeared to marginally increase referral frequency (60.7%; 51.8%).

Table 3 PHCP referral practice*

	Frequent Referral n (%) (weekly or monthly) Total n=109	**Infrequent referral n (%) (>monthly or no referral) Total n=113**
Staff type		
GP (n=28)	10 (35.7)	18 (64.3)
PN (n=120)	57 (47.5)	63 (52.5)
ANP (n=57)	32 (56.1)	25 (43.9)
Other (ECP/NP/Pharm/HCA) (n=17)	10 (58.8)	7 (41.2)
CPD Respiratory Qualification	84 (77.1)	59 (52.2)
Years in Practice > 10 years**	65/107 (60.7)	58/112 (51.8)

*11/99 online PHCPs specified that they referred to PR but did not specify referral frequency and were removed from this analysis.
** 107/109 and 112/113 reported time spent in general practice

40/233 (17.2%) responding PHCPs reported never referring to PR, with the largest group being practice nurses (29/40; 72.5%). 33 of 40 PHCPs offered a variety of reasons for non-referral including; not considering it to be part of their role, not seeing COPD patients or not knowing they could refer (12/33; 36.4%). Others reported it was undertaken by other respiratory specialist/interested health care professionals across primary and secondary care settings (12/33; 36.4%). Further reported reasons were unsure how to and/or a lack of training (5/33; 15.1%), uncertainty about local service provision (3/33; 9.1%) and 1/33 (3.0%) reported belief that patients were not interested.

Phase 1 Results: TDF analysis of the qualitative interviews

Table 4 shows the referral behaviour of PHCPs mapped to all 14 TDF domains. The most frequently mapped domain was social and professional role (n=287 times) whilst the least mapped was behavioural regulation (n=4).

Table 4: Phase 1 Mapping of barriers and enablers for referral to TDF domains

TDF Domain (construct mapping frequency)	Content mapping (n)	Key points	Evidence supporting
1.Social and Professional Role (A coherent set of behaviours and displayed personal qualities of an individual in a social or work setting)	(n=289)	Referral was considered everyone's role, however it was considered best undertaken by the PHCP during disease stability and at annual review. It was often considered to be the practice nurses' role, but also respiratory-interested others. Most PHCPs considered it their duty of care to motivate patients. Only 1 of 19 PHCPs described implementing practice leadership to improve PR awareness and/or referral.	*It is largely the nurses' job to see stable COPD patients at an annual review and that is the most appropriate time to refer to pulmonary rehabilitation, not during an acute exacerbation' –GP5* *No, I think it's everybody's role, I mean I'm not sure about my non-respiratory colleagues.* PN2 *So we've put forward a proper business case for it. (Local PR service).* GP4
2.Knowledge (An awareness of the existence of something)	(n=256)	17 of 19 PHCPs knew of the existence of PR and a generalised understanding of its purpose. PR Knowledge was reported to be gained through post qualification education and networking events. Local PR knowledge such as programme timing, waiting list (if any), and availability of patient transport, was often unknown and were described as inhibitors to referral discussions. The referral criteria Medical Research Council (MRC) dyspnoea Score ≥3 was frequently cited as a referral prompt, although some PHCPs wanted to refer patients with MRC scores of 2 and felt unable to.	*I think it's a fundamental treatment and I think it's better than drugs.* PN7 *Do you currently refer to PR? P -I wouldn't know where.* GP2 *I don't know how to describe pulmonary rehab to a patient.* GP3 *I just feel that we don't know enough about the program to confidently hand on your heart sell it.* PN1 *'We've also got the barrier of we can only refer if their MRC is 3 or 4 or 5'* PN5
3. Environment (Any circumstance of a person's situation or environment that discourages or encourages the development of skills and abilities,	(n=195)	PR referral was often considered inappropriate in non-COPD focused consultations or when a patient was consulting for an acute exacerbation. Clinical time constraints were often described as inhibiting referral, although annual review considered appropriate time	*I think in our role when you're treating potentially acutely unwell people in a really limited time span then it's, it is realistically going to be hard to cover everything, really hard.* ANP2

independence, social competence, and adaptive behaviour)		because of its clinical focus, template design and longer consultation time. PHCPs often stated little PR promotional material was available in practice for patients or staff; there were however mixed views on the potential value of this. 3 practices had initiated an in-practice 12 weekly, 1 hour generic exercise group, this appeared to be seen as equivalent to PR by 1 PN.	*On the annual review well I follow the template and when I get to the pulmonary rehab I mention it then and I say, 'Would you like to go?'* PN3 *It would be useful for our local organisation I think to give us some little leaflets about what they do so we can give that to patients about the local service* ANP4 *I'm not against a leaflet but have you seen how many posters and leaflets we have on our walls?* GP2
4.Belief about capabilities (Acceptance of the truth, reality, or validity about an ability, talent, or facility that a person can put to constructive use)	(n=141)	Individual PHCP PR referral confidence varied, with particular uncertainty expressed in how to best 'sell PR' and how to motivate un-motivated patients. Although most were confident in reassuring patients that PR would improve breathlessness. PHCPs with positive non-pharmacological and exercise beliefs appeared to have greater confidence in PR benefit and patients' abilities A number of PHCPs described COPD patients as uninterested in improving their health and some PHCPs emphasised patients needed to be committed to PR. Whilst some PHCPs described 'knowing' which patients would accept referral, others described undertaking subjective patient assessment and expressed concerns about patients' exercise capability in the presence of breathlessness. For patients receiving oxygen therapy there was much uncertainty of the benefit of PR and an assumption that Oxygen/secondary care teams would have previously offered this. Most PHCPs considered key environmental factors such as session timing, venue accessibility, patient financial hardship, as barriers for most patients. Patients in work, or	*I would need to feel confident, before I speak to this patient about it*. ANP4 *I quite like... Non-medicinal treatment…think if you're excited by it then it's easier for patients to get excited by it as well.* GP4 *They are also very very clear that there not going to take anyone on their course unless there is 100% commitment at the beginning that they are going to complete the course.* ANP1 *You look at the ones that you think would more likely go.* ANP4 *It's really basically where I see a need, where I see they can benefit – ANP1* *If the patients already on oxygen therapy, then it's likely that they've already been seen by them.* HCA *The main stumbling block is that you come across is " I'm not going every week for x number of weeks, I can't afford it, I haven't got that much time, how do you expect me to get there ….not a huge number of our patients drive.* GP4

		those able to take the dog for a walk/wearing walking boots were considered 'too well' for PR.	*There's some patients that I would like to refer but they can't go because of work commitments.* PN3 *'It's quite surprising that some patients are still working at odd jobs and things like that and keep them very active. So, for those patients it's not so important.'* PN3
5.Memory (Inc: Decision making) (The ability to retain information, focus selectively on aspects of the environment and choose between two or more alternatives)	(n= 118)	Some PHCPs reported forgetting to refer patients to PR, however, embedded system reminders often found in COPD review templates or on-screen prompts were cited as important for most PHCPs. Patient behaviour and clinical presentation altered decision making processes for some PHCPs for example not referring current smokers, or remembering PR in light of increasing COPD symptom burden and disease deterioration, whilst earlier concerns for patient capability and commitment became less apparent.	*I do need a reminders because my head's full, so as I say, I don't want to tick boxes but I do need a prompt.'* PN7 *That's something that we do, so we have a prompt that pops up saying has this patient been referred to pulmonary rehab.* GP5 *I think I go through phases, I'll do it really well for a while and somebody has motivated me and then I'll forget that and do something else.* PN7 *Breathlessness and exacerbations, I think, would be the key factors.* GP3
6.Optimism (The confidence that things will happen for the best or that desired goals will be attained)	(n=110)	PHCPs frequently reported that patients did not want to attend PR, citing disease stigma and lack of activation as underlying reasons. Negative patient responses appeared to dampen PHCPs optimism and reduce subsequent referral offers. Positive patient experience however had the opposite effect. Positive and negative perceptions of PR providers were also reported on the basis of service quality and frequency of referral acceptance, this appeared to influence referral behaviour.	*The first thing you think, 'Are they going to do it?* ANP4 *Patients don't want it.* PN5 *Even if you then said what the evidence was and how you could improve, it's – I think that group of people are really difficult to engage* .GP3 *If they're negative anyway everything you suggest they sort of have an answer, 'Oh no that won't work.* PN4 *The longer the wait time, the less likely they are to turn up. HCA* *I don't think it's the greatest service, it does have an impact because I'm not going to tell my patients to go.* PN7

7.Belief about consequences (Acceptance of the truth, reality, or validity about outcomes of a behaviour in a given situation)	(n=107)	There was a general sense that PR is positive with many health and psychological benefits, but beliefs captured in other domains impacted on PHCP belief about consequences of referral offer. A small number of PHCPs expressed concern that PR might worsen patient's depression and/or anxiety, particularly for those socially isolated.	*I've seen patients that have been… their lives have been transformed in the first year.* PN7 *Might have prevented the exacerbation if they'd gone* PN5 *I will say that when I'm talking to patients, say it's better than drugs, but I still get a closed reaction.* PN7 *If we can improve patient's breathing they're less likely to get anxious, that makes them less likely to dial 999 or likely to do something about it. And perhaps use their rescue packs more appropriately.* ANP4 *I wouldn't want to mention it if it ended up being that I'm saying there's this really good helpful programme but actually if she's so effected by her disease that she doesn't leave the house then I wouldn't want to have mentioned it and then not for her not to be able to go.* ANP2
8.Social Influences (Those interpersonal processes that can cause individuals to change their thoughts, feelings, or behaviours)	(n=84)	Out of practice engagement from PR providers and PR advocates were important in increasing overall awareness and positively influencing referral behaviour. Almost all PHCPs described little to no engagement from providers themselves, and described not knowing what had happened to completed referrals. PHCPs also reported that positive patient PR experiences positively influenced PHCPs referral behaviour and that family can be influential, yet patients rarely ask for PR. PHCPs described a need to increase PR's profile publicly and for it to be marketed similarly to pharmacological treatments. The name PR itself was considered by some PHCPs to be a negative influence as 'rehab' was deemed to have undesirable connotations.	*Our referral rate has gone up a lot since the respiratory MDT's because every single one of those patients has subsequently had a referral*. GP4 *At the moment I wouldn't know how many people we refer, is that referral going up, Nobodies giving us feedback from the rehab team about how we are doing as a surgery.* PN1 *If patients that have been to it you know express a positive experience that is something you can share with other people that you are trying to refer.* GP1 *I asked him to talk to his wife, because I knew she'd want him to go, because I know her through a different channel, and erm... he's come back and said 'Ooo I'll give it a shot.* PN5

			Nobody has picked up a leaflet and walked in with it and said can you refer me, nobody has. ANP1
9.Skills (An ability or proficiency acquired through practice)	(n=79)	The physical act of referring patients to PR were described as largely straightforward by most PHCPs, although there was no standardised process across the 2 regions. Most undertook this action independently, although there were descriptions of practice administrators helping. However, frequency of referral to PR when described in interviews, was far lower than that which was documented on the returned research interest form.	*Do you currently refer people to pulmonary rehab? Some, some.* PN7 *I've been at this practice for nearly three years now and it's sort of something that falls really far down on your list of things that you do on your COPD review, so it's always the last thing that you come to.* GP4 *It's very easy. It's a form erm it's a just a single sheet.* PN2 *Quicker, easier referral, much easier referral method* PN7
10.Reinforcement (Increasing the probability of a response by arranging a dependent relationship, or contingency, between the response and a given stimulus)	(n=59)	There appeared to be no direct sanctions for non-referral of patients, although practice financial rewards in one region appeared to enhance awareness and referral. Outside of these practices there was a suggestion that financial incentives would be advantageous, additionally calculating health cost benefit for PR attendance was suggested as potential enabler. Additionally reinforcements such as those offered by social influences and patients were also described to be valuable.	*We've got this thing called A** that we're doing for, you know it was the QOF before, so like A** has taken over that so I think because of the A** the doctor who is the lead A** leader he discusses that a lot because of course you get points, you still get the points for it like QOF. So the more we refer is the more points we get so there's an incentive there for the practice.* PN6 *Yeah if they did something on the BBC or something they might all be in the next day saying, 'Oh I wanna do that'.* PN4 *If you spent 5 minutes with somebody then at the end of that they agreed to go and then they attended, then you would be motivated to do it again.* GP5
11.Goals (Mental representations of outcomes or 'end states' that an individual wants to achieve)	(n=47)	Referral to PR was a low-level goal for most PHCPs, but one that varied by consultation type and was not considered during an acute exacerbation review. However, referral appeared to become a goal in the presence of worsening patient symptoms.	*As a practice, when we do the acute exacerbation we're pretty much focus on the acute exacerbation.* GP4 *I refer a few to pulmonary rehab but I don't do as many as I feel I should.* PN7

		Some PHCPs described wanting to refer more patients and learning strategies to improve patient acceptance, but described frequent discord between PHCP and patient goals which PHCPs found challenging. No PHCPs discussed set practice PR referral targets although one GP reported plans to set up a programme geographically closer to practice (captured as leadership in the domain social & professional.)	*She was more receptive because she'd had a few flares up, not after the first one but because she's had a few. And I think that makes them more receptive to doing that sort of thing*. ANP4 *One hand I'm wanting them to engage with the disease process so that actually they've got more skills to self-manage and that's going to actually keep them much better for the rest if their whole of their life, on the other hand they don't want to be classified as ill.* ANP1 *It would help me in trying to find out why she didn't go because I would challenge her on it and try and get her to go again and give it another go and that would help me in.* ANP4
12.Intentions (A conscious decision to perform a behaviour or a resolve to act in a certain way)	(n=39)	Some PHCPs have described adopting patient-aimed strategies that included persistence and warnings against overreliance and/or possible reduced effectiveness of pharmacological treatments in an effort to move patients to a state ready for PR referral. There also appeared to be an understanding that acceptance for many patients takes time.	*I said you know you've used those rescue packs a lot you know if we could get your breathing a bit better, perhaps you wouldn't be so bad….., and she said, alright then I'll see, do the referral.* ANP4 *How would you feel about something that's not medicine based but will probably help you as much as the inhalers that we've put you on, she was suddenly very interested in.* GP4 *I look for that chink of interest and then I'll try and worm my way in then.* PN7 *He was very adamant that he didn't want to go, then I gave him the booklet*. PN5
13.Emotion (A complex reaction pattern, involving experiential, behavioural, and physiological elements, by which the individual attempts to deal with a personally significant matter or event)	(n=6)	PHCPs emotion was rarely discussed although some said they felt annoyed with providers if a referral had been rejected. There were high levels of empathy towards patients particularly amongst nurses; a small number described not	*Most of our patients are reasonably trusting and say well you seem quite excited by it so shall we give it a try.* GP4 *They're gonna meet all these people they don't know and be told to lift this walk here, do that and they're frightened, its... I'd be terrified.* PN5

		wanting to offer the hope of PR to patients and for PR providers to reject referral, this appeared to be a particular concern for patients with high disease burden.	*I just don't want to raise – if you raise patients' hopes and say – and offer it, then it can make them – you know, if they're already depressed because of the COPD, it could just make the depression worse you know, so I don't want to impact on their mental wellbeing. ANP1*
14.Behavioural regulation (Anything aimed at managing or changing objectively observed or measured actions)	(n=4)	Some PHCPs saw events such as hospital admissions/out-patient appointments as good opportunities for patients to change behaviours but for staff in those settings to instigate referral. PHCP personal behavioural regulation was low, many did not know how any they had referred or what, post referral, the patient's journey had become. One participant described the research interview as helpful in allowing them to consider how to change their referral approach, but most PHCPs did not vocalise intentions to change or modify current or future PR referral behaviours.	*I don't know how much is done in secondary care, but very often when stuff, when you've been in anywhere near secondary care people really its often quite a sit up moment, gosh this is serious enough for me to have to go to hospital, even if it an outpatient appointment.* ANP1 *This is one of your treatment choices' and perhaps I need to change, thinking about it, my approach in – er, how I word it.* ANP4 *It's trying to make it a priority.* ANP4

Phase 2. Questionnaire results: Referral practice beliefs.

Table 5 presents the number and proportion of PHCPs that agreed or strongly agreed with each belief statement by frequency of referral.

320 Table 5 Results of TDF belief statements by referral frequency

TDF Domain	TDF Questions (n=54)	Frequent referral n=109 (%) (weekly/monthly)	Infrequent referral n=113(%) (>monthly or no referral)	Total n=222(%)
1.Knowledge	I am aware of the content of Pulmonary Rehabilitation (PR) Programmes	97/109 (89.0)	72/113(63.7)	169/222 (76.1)
	I am aware of PR programme objectives.	99/109 (90.8)	75/113 (66.4)	174/222 (78.4)
	I am unsure of the evidence base for PR	18/109(16.5)	30/113 (26.5)	49/222(21.6)
	I know where geographically my local PR programme is delivered	92/109 (84.4)	70/113(61.9)	162/222 (73.0)
	I know when it is appropriate to refer a patient with COPD to PR	106/109 (97.3)	74/113 (65.5)	180/222 (81.1)
	I can answer questions patients have about PR	88/109 (80.7)	60/113 (53.1)	148/222 (66.7)
	I know how to contact my local PR provider	91/109(83.2)	68/113 (60.2)	159/222 (71.6)
2.Skill	It is easy to refer a patient to PR	87/109 (80.0)	48/113 (42.5)	135/222 (60.8)
3.Social & Professional Role	Referral to PR is the practice nurse role	63/109 (57.8)	45/113 (39.8)	108/222(48.6)
	Other General Practice staff in my practice (excluding Practice Nurse) refer patients to PR	52/109(47.7)	63/113(55.8)	115/222 (51.8)
	I believe in encouraging patients to attend PR	109/109 (100)	104/112 (92.9)	213/221 (96.4)
4.Environment	Resources about PR (i.e written information) are readily available	39/109 (35.7)	25/112 (22.3)	64/221 (29.0)
	There is not enough time in practice to refer	12/109 (11.0)	22/113 (19.5)	34/222(15.3)
5.Social Influences	My local PR providers regularly engage with me	31/109 (28.4)	17/113 (15.0)	48/222 (22.6)

	PR is something that patients ask for	3/109 (2.8)	8/112 (7.1)	11/221 (5.0)
	There are good relationships in practice with PR providers	44/109 (40.4)	28/112 (25.0)	72/221 (32.6)
	PR providers are good at communicating outcomes of referrals I have made	39/109 (35.8)	25/112 (22.3)	64/221 (29.0)
6.Optimism (including pessimism)	I am confident my local PR provider offers a good service for my patients.	81/109 (74.3)	52/113 (46.0)	135/222 (60.8)
	I don't believe patients will attend PR after I have referred	16/109 (14.7)	16/113(14.2)	32/222(14.4)
	Patients who smoke are not motivated to take part in PR	7/109 (6.4)	7/113 (6.2)	14/222 (6.3)
	Patients who live alone won't like to take part in group PR	5/109 (4.6)	2/113 (1.8)	7/222 (3.2)
	Patients are motivated to attend PR	23/109 (21.6)	30/111 (27.0)	53/219 (24.2)
7.Belief about Capabilities (self)	I am confident in my ability to encourage patients to attend PR, even when they are not motivated	91/109(83.5)	73/113 (67.6)	164/222 (73.9)
	I do not find it easy to discuss PR with patients.	8/109(7.3)	25/113 (22.1)	36/222(16.2)
Belief about capabilities (patients)	Patients without their own transport won't be able to get to PR	40/109(36.7)	26/113 (23.0)	66/222 (29.7)
	Patients in work are not able to attend PR	62/109 (56.9)	35/113 (31.0)	97/222 (43.7)
	Patients who use home oxygen are unable to take part in PR	4/109(3.7)	6/113 (5.3)	10/222 (4.5)
8.Belief about consequences	If I keep pushing patients to attend PR this will disadvantage my relationship with them.	10/109 (9.2)	10/112 (8.9)	20/221 (9.0)
	I believe patients may be harmed by taking part In PR	1/109 (0.9)	1/113 (0.9)	2/222(0.9)
	I believe most patients will attend and complete PR following my referral	55/109 (50.4)	47/112 (42.0)	102/221 (46.2)
	PR is not beneficial to patients who are breathless	3/109(2.8)	3/113(2.7)	6/222 (2.7)

	PR is best suited to those patients with worsening breathlessness	29/109 (26.6)	29/112 (25.9)	58/221 (26.2)
	PR is **best** suited to those who have frequent exacerbations	27/109 (24.8)	28/112 (25.0)	55/221 (24.9)
	PR reduces hospital admissions	101/109 (92.7)	97/112 (86.6)	198/221 (89.6)
	PR reduces risk of mortality	85/109 (78.0)	82/112 (73.2)	167/221 (75.6)
	If patients attend PR this will reduce their general practice visits	73/109 (67.0)	78/112 (69.6)	151/221 (68.3)
	PR reduces exacerbations	88/109 (80.7)	84/112 (75.0)	172/221 (77.8)
	PR improves breathlessness	103/109 (94.5)	100/112 (89.3)	203/221 (91.9)
	PR reduces a patient's anxiety and/or depression.	97/108 (89.8)	96/112 (85.7)	193/220 (87.7)
9..Goals	Referring patients to PR is something I have been advised to do	95/107(88.8)	57/112(50.9)	152/219 (69.4)
	My practice regularly reviews COPD registers to ensure eligible COPD patients are offered PR	51/109 (46.8)	40/113 (35.4))	91/222 (41.0)
	There are set targets within the practice to improve PR referral rates	23/109 (21.1)	21/113 (18.6)	44/222 (19.8)
10. Memory (Inc.Decision Making)	I often forget to refer patients with COPD to PR	3/109 (2.8)	23/113 (20.4)	26/222 (11.7)
	Prompts to refer patients to PR within annual review templates are important reminders for me	72/109 (66.1)	69/112 (61.6)	141/221 (63.8)
	I only refer patients if they have quit smoking	1/109 (0.9)	3/113 (2.7)	4/222 (1.8)
	I only refer patients if they are optimised on their respiratory medication	17/109 (15.6)	12/113 (10.6)	29/222 (13.1)
	PR is most suited to COPD patients who have frequent exacerbations	20/109 (18.3)	20/113 (17.7)	40/221 (18.1)

	The best time to discuss PR referral with patients is when they are stable.	32/109 (29.4)	25/112 (22.3)	57/221 (25.8)
11.Reinforcement	More health care practitioners will discuss PR with patients because of the QoF incentive.	75/109 (68.8)	73/112 (65.2)	148/221 (67.0)
	My practice receives financial incentives for referral to PR (Before April 2019)	6/108 (5.6)	5/113 (4.4)	11/221 (5.0)
	I believe patient attendance to PR will increase because of the QoF Incentive.	41/109 (37.6)	58/112 (51.8)	99/221 (44.8)
	I believe the QoF incentive will not increase patients PR attendance	29/109 (26.6)	25/112 (2.3)	54/221 (24.4)
	There will be greater awareness of PR within practices because of the new QoF incentives.	84/109 (77.1)	71/112 (63.4)	155/221 (70.1)
12.Intentions	I will refer more patients to PR now there are practice QoF incentives (from April 2019)	30/109 (27.5)	42/112 (37.5)	72/221 (32.6)

In general, most PHCPs had some PR knowledge (especially the frequent referrers) and understood the beneficial consequences of PR. However, resources, social influences (such as relationship with PR providers) and pessimism about patient motivations were perceived barriers by a high proportion of PHCPs, irrespective of their referral practice.

There were however, differences in domains between frequent and infrequent PR referrers.

The greatest differences were within the 'Knowledge' domain. Frequent referrers most commonly reported agreement with all 7 statements, when compared to the infrequent referrers. For example, 97.3% reported knowing when to refer to PR and 80.7% being able to answer patients' questions versus 65.5% and 53.3% of infrequent referrers.

Further group differences were demonstrated in the 'Skills' domain and 'Beliefs about (PHCP) capabilities', which showed that infrequent referrers were less confident in encouraging unmotivated patients to attend PR (67.6% versus 83.5% of frequent referrers). Reduced confidence amongst infrequent referrers was further reflected within the 'Optimism' domain and belief statement 'I am confident my local provider offers a good service' (46% against 74.3% of frequent referrers). However, over half (56.9%) of frequent referrers felt that patients in work were not able to attend PR, compared to less than a third (31%) of those who referred infrequently.

The remaining belief statements demonstrated greater group similarities than differences. Environment, Social and Professional role: Most respondents felt that there was enough time in practice to refer (84.7%) and believed in encouraging PR attendance (96.4%). Yet promotional information on PR was rarely available in practices (29%). There was no clearly identified PR referrer; less than half (48.6%) felt it was the practice nurse's role and (51.8%) reported other practice staff refer.

Social influences: Frequent referrers were slightly more likely to agree with 3 of the 4 domain belief statements than infrequent referrers. Although, collectively the groups reported both PR provider engagement and referral outcome reporting as low at only 22.6% and 29% respectively. PHCPs also reported patients rarely request referral to PR (5%).

Belief about consequences and Optimism: Most PHCPs agreed that PR offers physical health benefits, including improving breathlessness and reducing hospital admissions (91.9%, 89.6%) respectively. Yet far fewer PHCPs believed patients would attend and complete PR (46.2%), with fewer still agreeing that patients are PR motivated (24.2%).

Memory (decision-making): Only a small number of PHCPs reported forgetting to refer patients to PR (11.7%). COPD annual review templates were reported as helpful referral reminders (63.8%) and 25.8% reported the best time to discuss referral with patients was during COPD stability. Patient characteristics such as disease stability and smoking status do not appear to impede PHCP referral decisions as 98.2% reported referring smokers.

Goals, Reinforcement and Intention: in-practice review of eligible patients was not commonly reported (41%) and only (19.8%) reported in-practice targets to improve referral rates. Practice financial reward for referral (pre April 2019) was rarely reported (5%); indeed the implementation of financial reward via national QoF incentives (post April 2019) was considered unlikely to greatly improve referral behaviours, with less than a third (32.6%) stating they would refer more. However, there was general agreement that this incentive would increase practice awareness of PR (70.1%).

Phase 2. Questionnaire: Open questions.

A third of PHCPs (33.8%) responded to the open question at the end of the survey including 5/11 PHCPs who reported referral, but did not specify frequency, (answer length 3-167 words, mean 35). Non-frequent referrers reported more open comments (43/113 38.1%) than frequent referrers (33/109 30.3%)

This gave an additional 94 comments that related directly to PR referral. These were content mapped to all 12 relevant TDF domains. The comments predominately cited referral barriers.

Belief about capabilities had the highest number of comments 36/94 (38.3%) with many encompassing concerns about PR accessibility, particularly transport challenges for patients. For example, '*Location of PR too far for patients to travel and too much commitment. Patients tend to be older adults on generally low incomes. A number of my patients would attend if it was close by with no expense'.* A small number of PHCPs (3.2%) considered a patient's inability to complete pre-

PR spirometry as a referral barrier, and 10.6% of comments related to referral processes, which were reported to be lengthy and as such *'easier simpler'* processes were requested.

Connected results

In order to identify the key factors that inhibit and/or enable PHCP referral to PR, Phase 1 and phase 2 results were merged to allow for data contrast and meta-inference (18) (Table 5).

Most PHCPs believed in PR and encouraging patients to attend. Referral is most likely to be considered at annual review (indeed referral is rarely offered to patients outside of this consultation). On-screen prompts are helpful reminders, but in practice material promoting PR is rare. PHCP PR knowledge is largely gained from networking with other respiratory interested health professionals and/or CPD education. PHCPs report patients have little motivation for PR, rarely ask for referral to PR and view that patients in work are unlikely to be able to attend.

Some findings of the qualitative study were not clearly replicated in the survey results. For example, phase one qualitative data highlighted that some GPs and ANPs felt the practice nurse was best placed to undertake PR referral at the time of annual review, yet respiratory interested GPs and those undertaking annual review did not share this view. The phase two survey data supported the latter position, where 29/129 (22.5%) of practice nurses reported never referring. Therefore responsibility of PR referral is not based on profession, but is undertaken by PHCPs who are respiratory interested and/or conducting the patient's annual review.

Qualitative generalisable findings were limited in a number of areas meaning clear conclusion cannot be drawn, these included; time available to undertake referral, ease of referral process, perceptions of quality of PR programme, referral of patients when COPD symptom burden is increasing and non-referral in order to protect patient relationship.

Where generalisability is clear, a summary of the key behavioural barriers and enablers by TDF domain are shown in figure 2, demonstrating a greater number of barriers than enablers

to referral. However, it is also important to report that barriers and enablers most commonly co-exist within the same domains.

Table 6 Integrated results matrix

✓Enabler and agreement with Phase 1 data.
✗ Barrier and agreement with Phase 1 data.

TDF Domain	Phase 1 Qualitative study Main Factors	Phase 2 Survey Main Factors	Barrier - ✗ / Enabler - ✓
Social and Professional Role	It is largely seen as the practice nurse role, or staff undertaking COPD review. The best time to refer a patient is when they are stable Most PHCPs believe in encouraging patients to attend.	Not clearly PNs role, but PHCP doing annual review is most likely referrer. Disagree Agree	PHCP undertaking annual review (not necessarily the PN)- ✓ Not generalizable in quantitative data. ✓
Knowledge	Generally a good basic knowledge Little detailed local programme knowledge Knowledge is largely gained from CPD/networking	Agree (Generally higher in frequent referrers) Disagree (Higher local knowledge in frequent referrers) Agree	Enabler – but room for improvement ✓ ✓
Environment	There is a lack of time in practice. Referral is only considered during non-acute COPD focused consultations. There is a lack of PR promotional material available in practices.	Disagree Agreed (some infrequent referrers reported not to see COPD patients) Agree	Not generalizable in the quantitative data. ✗ ✗
Memory	On screen reminders are important Referral prompted when patients have symptoms that are worsening	Agree Disagree	✓ Not generalizable in the quantitative data.
Optimism	Patients do not want PR/are not motivated PR providers do not offer a good service.	Agree Some agreement more so with infrequent referrers	✗ ✗
Belief about consequences	PR is good for patient's physical and psychological health. PR may harm patients (psychologically)	Agree Disagree Disagree	✓ Not generalizable in the quantitative data.

	Pushing PR might harm my relationship. Patients will not always attend and complete post referral.	General agreement.	Not generalizable in the quantitative data. ✗
Belief about capability	Talking to patients about PR is challenging. Patients in work are unable to attend PR Transport is a barrier Not for patients with oxygen Not for patients who smoke Best suited to those who have frequent exacerbations	Some agreement more so with infrequent referrers. Agree Agree (Open question) Disagree Disagree Disagree	✗ ✗ ✗ Not generalizable in the quantitative data. Not generalizable in the quantitative data. Not generalizable in the quantitative data
Social influences	Lack of PR provider engagement and feedback to referrer Patients do not ask for PR	Agree Agree	✗ ✗
Skills	Referral to PR by PHCP is low Referral process is relatively easy	Agree Disagreement, particularly by infrequent referrers.	✗ Likely barrier
Reinforcement	Financial reward increases referral rates Patients decline PR Financial reward increases practice awareness	Most don't think this would change behaviour. Not captured explicitly Agree	Not generalizable in the quantitative data Likely barrier ✓
Goals	No set in-practice process to improve or review referral rates.	Agree	✗
Intentions	Referral acceptance takes time General desire to refer more patients.	Not captured explicitly Not captured explicitly	Likely barrier Likely enabler
Emotion	PHCPs are fearful on behalf of patients Frustration with PR providers	Concern over access abilities (expressed in free text, may capture PHCP fear) Not captured explicitly.	✗ ✗
Behavioural Regulation	PHCPs do not know how many patients they have referred. PHCPs have no planned intentions to change behaviour	Agree Largely agree, although some emerging interventions (free text)	✗ Likely barrier

Figure 2 Key barriers and enablers by TDF domain.

Discussion:

Referral to PR from primary care remains poor. This is the first time the Theoretical Domains Framework has been applied to a mixed-methods study to understand the key factors that determine referral to PR by PHCPs. Results highlighted multiple intertwined barriers and few enablers. Many (although not all) of the findings from the qualitative study were affirmed by the more generalisable survey.

Although Cox et al (25) retrospectively applied the TDF to primary studies in order to identify the barriers and enablers to PR, the review only included a small number (n=2) of UK based HCP qualitative referrer studies. Reported referral facilitators were PR programme knowledge, successful HCP prior referral and patient PR accessibility. These mapping to two domains, knowledge and beliefs about consequences. Our study finds referral facilitators in an additional five TDF domains (as shown in figure 2). PHCPs reported believing that PR was beneficial for patients and wanting to refer more. They have however, requested greater engagement from providers, better knowledge of local programmes and improvements in PR promotion. They also reported in-practice goals and/or monitoring of referrals to address the shortfall in patients referred are rare.

However, PHCPs collectively reported low confidence in patients' abilities and motivations to attend PR, a belief likely to be strengthened by reports of few patients requesting referral. Beliefs about low uptake, may explain why referral is commonly offered at times of increasing COPD symptoms, thus acting as a lever to referral acceptance. Infrequent referrers reported reduced confidence in encouraging un-motivated patients to attend, with similar findings reported in phase 1 data as PHCPs expressed concerns around the protection of relationships with patients. Venue accessibility also appears to be a barrier and whilst the direct survey question (question 21) appeared not to overtly agree with this, both phase 1 and the phase 2 open question results highlighted transport a practical and cost barrier, affirmed by patient studies (25). Variability in referral rate by PHCP profession was an unexpected finding and offers insights that (1) few PNs refer and (2) where it is considered to be the 'respiratory nurse' role, referral opportunities may become reduced. Associative referral

frequency and respiratory qualification is also a new finding. ANPs were those most likely to refer and to have respiratory qualifications. This may reflect current nationwide upscaling of the nursing workforce and Master's educational requirements of ANPs (26).

Strengths and Limitations

Combining qualitative and quantitative methods in a mixed method research approach offered valuable insight into PHCP referral practices and is a key strength of this research. The range and number of PHCPs included from across the UK were broadly representative of the general practice workforce (27). We recognise that predominately respiratory interested participants may have taken part in this study which may skew results, and it is noted that online participants reported higher referral practice and respiratory qualification(s) than their counterparts, which may be a study limitation, suggesting that more emphasis should be placed on the perspective of the infrequent referrers. Adopting additional recruitment strategies such as via general practice-based conferences is seen as a study strength which sought to capture a range of PHCPs views. Demographic similarities across all 3 recruitment streams highlight study design attempts to reduce participation and sample selection biases. Questionnaire specific biases relating to self-reporting response is a source of potential weakness, specifically where responses maybe perceived to be 'socially acceptable', otherwise known as social desirability (28). This may offer some explanation around the variation observed in the belief about capabilities domain of the integrated results matrix (Table 6). Grouping participants by reported referral frequency is a study strength, particularly as the aim is to understand both what supports and inhibits referral.

Much of the validity of the TDF is gained from its direct application with HCPs, as utilised here. However transcript content mapping to 84 constructs is complex and time consuming as also described by others (29). Additionally, aligning content to a key domain was challenging, particularly where content could be mapped to more than one domain, for example patients declining PR impacted on belief about consequences, optimism and reinforcement domains. This has been previously reported as a TDF weakness (14), but its potential impact unclear. Mapping content to all relevant domains is an alternative approach (11), but was discounted on the basis of practicality and interpretation complexity. The TDF offers a functional approach to behavioural data analysis, most likely to be helpful when there is little to no underlying knowledge of the investigating phenomenon. However, the

interrelations between referrer, patient and provider have previously been reported to be important factors in the referral journey (7). Yet, the TDF does not offer causal determinants of behaviour (11) and alignment to predetermined domains reduces the ability to consider any phenomena falling outside those domains and the likely connecting relations, meaning the whole picture maybe missed and is a potential limitation.

One researcher (JW) is an experienced respiratory nurse specialist which may have altered analysis, although transparency and team analysis sought to reduce potential bias.

Relation to other studies.

This mixed methods TDF based study finds agreement with many key referral factors presented in our previous inductive qualitative study using the same data (7). However, it disputes that the PN is the main referrer to PR within primary care, and questions the value of practice based financial reward as a referral incentive. It also highlights that the referral process itself is not straightforward and there are no sanctions for non-referral, but there is time in practice to refer. Increasing the population sample and geographical reach in this study strengthens current known practice referral barriers including, poor patient motivation, few in-practice resources, perceived venue access difficulties and little awareness of local PR provision (25, 30-33). Subjective patient assessments including PHCPs perceptions of patients capabilities and motivations have been described as influencing PHCP referral decisions here and previously published (7). This is a novel finding in relation to PR referral, yet similar HCP pessimistic attitudes, relating to a patient's capability and motivation to access services and change behaviours to improve health outcomes have been reported in the primary healthcare management of reducing cardiovascular disease risk in people with serious mental illness (34, 35).

Phase one and inductive data analysis (7) suggested that offering PR at COPD symptom increase was common yet this was unconfirmed in the survey results. This may demonstrate further social desirability reporting as previous analyses have demonstrated patients attending PR to have 1.24 hospitalisations per patient-year 95% CI (0.66-2.34) suggesting sicker patients are those most likely to be offered PR (36). However, referral at this time supports both PHCP and patients' concerns about patient's capabilities (7, 25, 37), meaning lower acceptance and adherence to PR is probable, and negative PHCP beliefs about outcomes are

likely to perpetuate. An alternative approach and one that appears not to be currently undertaken is to refer at the point of an acute exacerbation of COPD, which maybe a referral lever (11, 37).

In our original inductive analysis (7), we reported that financial incentives may be important, yet results in this current study are mixed and PHCPs appear uncertain of their value. It will be interesting to observe the impact of the newly implemented financial rewards for PR referral in England, but where similar QoF rewards were implemented for referral to diabetes programmes, uptake did not greatly improve (38). Given positive correlations between referral rates and CPD education, efforts to increase the number and education of the primary care workforce by Health Education England (39) is encouraging. The literature also supports a general consensus that for patients in employment, PR is largely considered inaccessible (7)(28). This was reported as a barrier by the frequent referrers more than the infrequent referrers, which questions whether PR knowledge itself is a potential barrier as previously reported (7) and that PHCP beliefs influence subsequent referral behaviours.

Conclusions

This is the first mixed methods research study to examine the factors that inhibit and enable referral to PR for patients with COPD from a primary care perspective. Whilst knowledge and respiratory qualification appear to be enablers, many barriers persist which must be overcome to increase referral opportunities for all eligible patients. The most important aspects to address are to increase PR provider engagement with referrers, increase PR awareness and support for potential patients and all PHCPs, including those with respiratory qualifications and to increase PHCP internal motivation for PR referral, particularly for those patients in work and those with less symptom burden. These suggestions are likely to require multi-system changes. Mapping these TDF findings to behaviour change techniques (BCT) are important next steps which will enable clear targeted interventions to be identified and tested in clinical practice, which will ultimately increase referral to PR, thereby improving COPD patients' health outcomes and reducing health service utilization.

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Ethics approval and consent to participate

Ethical Approvals: Phase 1 approval granted by Health Research Authority: Project ID: 213367. Phase 2 approval granted by University of Birmingham: ERN_19-0439. All participants in phase 1 and phase 2 studies gave consent.

Consent for publication

Not Applicable

Availability of data and material

The datasets during and/or analysed during the current study available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests"

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Authors' contributions

JW collected, analysed and interpreted phase 1 and phase 2 data and was a major contributor in writing the manuscript. RJ, PA, SG and AE contributed to study design, data analysis and interpretation of phase 1 and 2 data. RJ, PA and SG all contributed to the writing of the manuscript. IV supported phase 1 topic guide development, phase 1 data alignment to the TDF and the formulation of the phase 2 questionnaire where behavioural expert consensus was sought. All authors read and approved the final manuscript.

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Figure 1

Figure 1: Exploratory sequential design

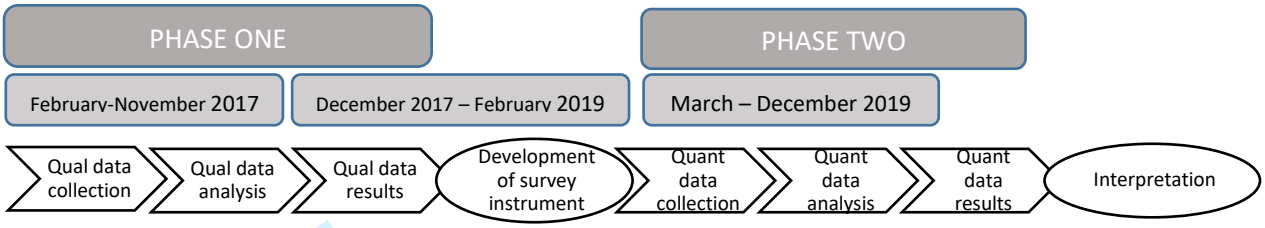
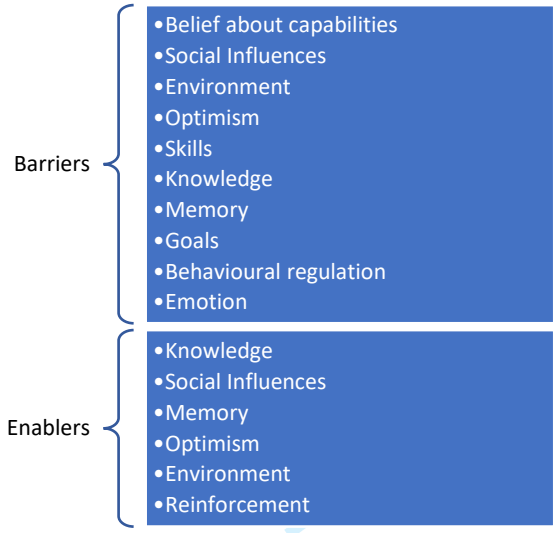


Figure 2: Key barriers and enablers by TDF domain.



Additional File 2: Phase 1 interview guide

Understanding barriers and enablers for primary care health staff when referring patients with Chronic Obstructive Pulmonary Disease (COPD) to Pulmonary Rehabilitation: a qualitative study. Topic Guide for Interviews.

Interview Objectives:

- To explore the experience of primary care practitioners in relation to referral of patients with COPD to pulmonary rehabilitation.
- To gain an understanding of the main perceived barriers and enablers for referring COPD patients for pulmonary rehabilitation.
- To gain insight into whether any patient characteristics influence whether or not people with COPD are referred for pulmonary rehabilitation.

Understanding current behaviour

To start the discussion, participants will be asked to talk about their experiences of managing patients with COPD in primary care and any experience of referral for pulmonary rehabilitation

1/ Could you tell me in what context do you currently see COPD patients? (Exposure to population/target intervention within working role e.g. planned – annual review/flu jab or unplanned - exacerbation)

2/ On average how many COPD patients do you think you see per week?

3/ Do you currently refer to PR programmes?

Capability, Opportunity, Motivation – including External Context

4/ What is your understanding/view surrounding Pulmonary Rehabilitation programs in general? And in relation to your local provider?….

5/ Do you think pulmonary rehabilitation is beneficial for patients? In what ways? Or why not?

6/ How easy or difficult is it for you to refer to your local PR provider?

(Eg. Is it your role to refer? When is it appropriate to refer COPD patients to PR?)

7/ What motivates you to refer patients to PR ?

(Eg. Do patients/carers ever ask you about pulmonary rehabilitation? Does the post PR patient summary motivate you, are you reminded by prompts or other guidance?)

8/ What do you think stops you from referring patients to pulmonary rehabilitation?

Images Alternating images (between 1-4)

9/ If this person was in your COPD patient, would you consider discussing PR with them? Why? Why not?

Future

10/ Is there anything that you think could improve the primary care discussion surrounding PR and/or encourage you to make referrals to PR?

Possible prompts: Do you think a short video clip would help you motivate patients? Or computerised prompts to follow? Or a further telephone call to encourage patients? Or a firm appointment slot to discuss PR with them?

Additional file 3 TDF domain alignment using construct labelling (1)

Domain	Constructs
1.Knowledge (An awareness of the existence of something)	Knowledge (including knowledge of condition /scientific rationale) Procedural knowledge Knowledge of task environment
2. Skills (An ability or proficiency acquired through practice)	Skills Skills development Competence Ability Interpersonal skills Practice Skill assessment
3. Social/Professional Role and Identity (A coherent set of behaviours and displayed personal qualities of an individual in a social or work setting)	Professional identity Professional role Social identity Identity Professional boundaries Professional confidence Group identity Leadership Organisational commitment
4. Beliefs about Capabilities (Acceptance of the truth, reality, or validity about an ability, talent, or facility that a person can put to constructive use)	Self-confidence Perceived competence Self-efficacy Perceived behavioural control Beliefs Self-esteem Empowerment Professional confidence
5. Optimism (The confidence that things will happen for the best or that desired goals will be attained)	Optimism Pessimism Unrealistic optimism Identity
6. Beliefs about Consequences (Acceptance of the truth, reality, or validity about outcomes of a behaviour in a given situation)	Beliefs Outcome expectancies Characteristics of outcome expectancies Anticipated regret Consequents

7. Reinforcement (Increasing the probability of a response by arranging a dependent relationship, or contingency, between the response and a given stimulus)	Rewards (proximal / distal, valued / not valued, probable / improbable) Incentives Punishment Consequents Reinforcement Contingencies Sanctions
8. Intentions (A conscious decision to perform a behaviour or a resolve to act in a certain way)	Stability of intentions Stages of change model Transtheoretical model and stages of change
9. Goals (Mental representations of outcomes or end states that an individual wants to achieve)	Goals (distal / proximal) Goal priority Goal / target setting Goals (autonomous / controlled) Action planning Implementation intention
10. Memory, Attention and Decision Processes (The ability to retain information, focus selectively on aspects of the environment and choose between two or more alternatives)	Memory Attention Attention control Decision making Cognitive overload / tiredness
11. Environmental Context and Resources (Any circumstance of a person's situation or environment that discourages or encourages the development of skills and abilities, independence, social competence, and adaptive behaviour)	Environmental stressors Organisational culture /climate Resources / material resources Salient events / critical incidents Person x environment interaction Barriers and facilitators
12. Social influences (Those interpersonal processes that can cause individuals to change their thoughts, feelings, or behaviours)	Social pressure Social norms Group conformity Social comparisons Group norms Social support Power Intergroup conflict Alienation Group identity Modelling
13. Emotion	Fear Anxiety

(A complex reaction pattern, involving experiential, behavioural, and physiological elements, by which the individual attempts to deal with a personally significant matter or event)	Affect Stress Depression Positive / negative affect Burn-out
14. Behavioural Regulation (Anything aimed at managing or changing objectively observed or measured actions)	Self-monitoring Breaking habit Action planning

1. 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(37).

Additional File 4:General Practice Staff experiences of referring patients with COPD to PR

Thank you for taking the time to complete this questionnaire, which aims to gather perspectives from staff working in primary care. This survey is designed for us to find out some of the barriers staff face when considering referring a patient with COPD to PR so please answer the questions as honestly as you can. This should only take you around 15 minutes to complete. First, please complete the following information

Geographical location of practice (please circle)	England North East North West Yorkshire and the Humber East Midlands West Midlands East of England London South East South West Scotland Wales NI
Profession (please circle)	GP/Trainer Practice Nurse ANP Other (ECP/HCP/Pharmacist)
Age (years)	18-29 30- 39 40 – 49 50- 59 60 +
Gender	Female Male
What is your ethnic group? Please circle one option that best describes your ethnic group or background	**White** English Welsh Scottish Northern Irish British Irish Gypsy, Traveller or Irish Traveller Any other White background: **Mixed/ Multiple ethnic groups** White and Black Caribbean White and Black African White and Asian Any other Mixed/ Multiple ethnic background: **Black/ African/ Caribbean/Black British** African Caribbean Any other Black/ African/ Caribbean background **Asian/ Asian British** Indian Pakistani Bangladeshi Chinese Any other Asian background: **Other ethnic group** Arab Any other ethnic group:
Do you see patients with COPD for (please circle as many as relevant)	Acute management Chronic management Both Neither
No. of years in general practice	Years: …….. Months: ……
Respiratory Qualifications	None COPD Diploma Asthma Diploma ARTP Spirometry Other
Do you currently refer patients with COPD to pulmonary Rehabilitation?	Yes - If yes - Weekly Monthly Less than monthly No - if no please explain why ……

This questionnaire is designed to ask you about your experiences with referring (or considering referring) patients with COPD to Pulmonary Rehabilitation and should take no more than **15 minutes** to complete. Please don't spend too long thinking about each question.

The questionnaire is made up of 4 elements. When rating your level of agreement with each phrase, please think about **all the things that might affect you being able to discuss pulmonary rehabilitation with your patients as well as refer.**

Please indicate your level of agreement with the following statements:

Question list	Strongly Disagree	Disagree	Neither disagree nor agree	Agree	Strongly Agree
1. I am aware of the content of Pulmonary Rehabilitation (PR) Programmes	1	2	3	4	5
2. I am aware of PR programme objectives.	1	2	3	4	5
3. I am unsure of the evidence base for PR	1	2	3	4	5
4. I know where geographically my local PR programme is delivered	1	2	3	4	5
5. I know when it is appropriate to refer a patient with COPD to PR	1	2	3	4	5
6. I can answer questions patients have about PR	1	2	3	4	5
7. I know how to contact my local PR provider	1	2	3	4	5
8. My local PR providers regularly engage with me	1	2	3	4	5
9. It is easy to refer a patient to PR	1	2	3	4	5
10. I am confident my local PR provider offers a good service for my patients.	1	2	3	4	5
11. Referral to PR is the practice nurse role	1	2	3	4	5
12. Other General Practice staff in my practice (excluding Practice Nurse) refer patients to PR	1	2	3	4	5
13. Referring patients to PR is something I have been advised to do	1	2	3	4	5
14. I am confident in my ability to encourage patients to attend PR, even when they are not motivated	1	2	3	4	5
15. I do not find it easy to discuss PR with patients.	1	2	3	4	5
16. I don't believe patients will attend PR after I have referred	1	2	3	4	5
17. Patients in work are not able to attend PR	1	2	3	4	5
18. PR is not beneficial to patients who are breathless	1	2	3	4	5
19. Patients who use home oxygen are unable to take part in PR	1	2	3	4	5
20. Patients who smoke are not motivated to take part in PR	1	2	3	4	5
21. Patients without their own transport won't be able to get to PR	1	2	3	4	5
22. Patients who live alone won't like to take part in group PR	1	2	3	4	5
23. I only refer patients if they have quit smoking	1	2	3	4	5
24. I only refer patients if they are optimised on their respiratory medication	1	2	3	4	5

Question list	Strongly Disagree	Disagree	Neither disagree nor agree	Agree	Strongly Agree
25. PR is most suited to COPD patients who have frequent exacerbations	1	2	3	4	5
26. My practice receives financial incentives for referral to PR (Before April 2019)	1	2	3	4	5
27. My practice regularly reviews COPD registers to ensure eligible COPD patients are offered PR	1	2	3	4	5
28. There are set targets within the practice to improve PR referral rates	1	2	3	4	5
29. I often forget to refer patients with COPD to PR	1	2	3	4	5
30. There is not enough time in practice to refer	1	2	3	4	5
31. I believe patients may be harmed by taking part In PR	1	2	3	4	5
32. Prompts to refer patients to PR within annual review templates are important reminders for me	1	2	3	4	5
33. The best time to discuss PR referral with patients is when they are stable.	1	2	3	4	5
34. Patients are motivated to attend PR	1	2	3	4	5
35. PR is best suited to those patients with worsening breathlessness	1	2	3	4	5
36. PR is best suited to those who have frequent exacerbations	1	2	3	4	5
37. I believe in encouraging patients to attend PR	1	2	3	4	5
38. PR reduces hospital admissions	1	2	3	4	5
39. I believe most patients will attend and complete PR following my referral	1	2	3	4	5
40. PR reduces risk of mortality	1	2	3	4	5
41. If patients attend PR this will reduce their general practice visits	1	2	3	4	5
42. PR reduces exacerbations	1	2	3	4	5
43. PR improves breathlessness	1	2	3	4	5
44. PR reduces a patient's anxiety and/or depression.	1	2	3	4	5
45. If I keep pushing patients to attend PR this will disadvantage my relationship with them.	1	2	3	4	5
46. There are good relationships in practice with PR providers	1	2	3	4	5
47. PR providers are good at communicating outcomes of referrals I have made	1	2	3	4	5
48. Resources about PR (i.e written information) are readily available	1	2	3	4	5
49. PR is something that patients ask for	1	2	3	4	5

Question list	Strongly Disagree	Disagree	Neither disagree nor agree	Agree	Strongly Agree
50. I will refer more patients to PR now there are practice QoF incentives (from April 2019)	1	2	3	4	5
51. There will be greater awareness of PR within practices because of the new QoF incentives.	1	2	3	4	5
52. More health care practitioners will discuss PR with patients because of the QoF incentive.	1	2	3	4	5
53. I believe patient attendance to PR will increase because of the QoF Incentive.	1	2	3	4	5
54. I believe the QoF incentive will not increase patients PR attendance	1	2	3	4	5

2/Please consider the interventions below. Please rate each possible intervention based on which you think would be the most helpful in improving your rates of referral to PR?

3/ Then please indicate the top 5 that you think will be the most effective in increasing PR referral within your practice. Please rank them in order 1 (highest) – 5 (lowest) in the 'Rank" column.

Question list	Strongly Disagree	Disagree	Neither disagree nor agree	Agree	Strongly Agree	Rank (1-5)
1. Health Care Professional (HCP) referring patients to PR at the time of COPD diagnosis.	1	2	3	4	5	
2. HCP prescribing PR at the time of COPD acute exacerbation.	1	2	3	4	4	
3. A standardised summary (i.e: a 2 sentences) that describes PR succinctly for HCP to recite to eligible patients.	1	2	3	4	5	
4. Face to face educational sessions for general practice staff.	1	2	3	4	5	
5. Online educational sessions for general practice staff.	1	2	3	4	5	
6. Face to face educational sessions for potential patients, carers and family.	1	2	3	4	5	
7. Online educational sessions for patients, carers & family.	1	2	3	4	5	
8. Practice staff loaning DVDs which demonstrate PR to patients.	1	2	3	4	5	
9. HCP showing patients PR recording within practice or consultation ie on a tablet device.	1	2	3	4	5	
10. Past PR patient attenders directly engage with eligible patients to highlight benefits.	1	2	3	4	5	
11. PR providers directly contacting eligible practice patients.	1	2	3	4	5	

Question list	Strongly Disagree	Disagree	Neither disagree nor agree	Agree	Strongly Agree	Rank
12. PR providers engaging with practice staff by coming into surgeries.	1	2	3	4	5	
13. Personalised letters to eligible patients from general practice advocating PR.	1	2	3	4	5	
14. Group consultations with patients, general practice staff and PR provider.	1	2	3	4	5	
15. Patients being able to refer themselves to PR.	1	2	3	4	5	
16. Patients having their own COPD health care record, similar to a COPD passport, meaning they are prompted to ask for PR.	1	2	3	4	5	
17. PR promotional material within patient pharmacy medication packs	1	2	3	4	5	
18. Greater awareness of PR in practice. i.e Posters highlighting local PR provider, benefits, etc.	1	2	3	4	5	
19. General practice staff being able to refer patients by telephone rather than manually completing referral form.	1	2	3	4	5	
20. If my practice referred more COPD patients this would increase my own referral numbers.	1	2	3	4	5	
21. Changing the name of PR to something more user friendly.	1	2	3	4	5	
22. General practice staff being taught motivational interviewing techniques would improve referral to PR.	1	2	3	4	5	
23. Lead practice PR referrer to educate and show PR video to other practice staff at practice meetings, to encourage a whole practice approach.	1	2	3	4	5	

4/ Please add any further comments/suggestions you may have……

……

……

……

……

……

Many thanks for completing this questionnaire. Please return to the return box to collect your chocolate(s).

Additional file 1

Guidelines for Conducting and Reporting Mixed Research for Counselor Researchers (1)

Research Formulation	
1.1.1. Treat each relevant article as data that generate both qualitative (e.g., qualitative findings, literature review of source article, source article author's conclusion) and quantitative (e.g., p values, effect sizes, sample size score reliability, quantitative results) information that yield a mixed research synthesis. 1.1.2. Subject each document selected as part of the literature review to summarization, analysis, evaluation, and synthesis. 1.1.3. Provide literature reviews that are comprehensive, current, and rigorous; that have been compared and contrasted adequately; and that contain primary sources that are relevant to the research problem under investigation, with clear connections being made between the sources presented and the present study. 1.1.4. Present clearly the theoretical/conceptual framework. 1.1.5. Assess the findings stemming from each individual study and the emergent synthesis for trustworthiness, credibility, dependability, legitimation, validity, plausibility, applicability, consistency, neutrality, reliability, objectivity, confirmability, and/or transferability. 1.1.6. Present the goal of the study (i.e., predict; add to the knowledge base; have a personal, social, institutional, and/or organizational impact; measure change; understand complex phenomena; test new ideas; generate new ideas; inform constituencies; and examine the past).	Pages 3/4/5
1.2.1. Specify the objective(s) of the study (i.e., exploration, description, explanation, prediction, and influence). 1.3.1. Specify the rationale of the study. 1.3.2. Specify the rationale for combining qualitative and quantitative approaches (i.e., participant enrichment, instrument fidelity, treatment integrity, and significance enhancement). 1.4.1. Specify the purpose of the study. 1.4.2. Specify the purpose for combining qualitative and quantitative approaches (e.g., identify representative sample members, conduct member check, validate individual scores on outcome measures, develop items for an instrument, identify barriers and/or facilitators within intervention condition,	Title & pages 3 & 4

evaluate the fidelity of implementing the intervention and how it worked, enhance findings that are not significant, compare results from the quantitative data with the qualitative findings). 1.5.1. Avoid asking research questions that lend themselves to yes/no responses. 1.5.2. Present mixed research questions (i.e., questions that embed both a quantitative research question and a qualitative research question within the same question) when possible.	As above
Research Planning 2.1.1. Specify the initial and final sample sizes for all quantitative and qualitative phases of the study. 2.1.2. Present all sample size considerations made for the quantitative phase(s) (i.e., a priori power) and qualitative phases (e.g., information-rich cases). 2.1.3. Present the sampling scheme for both the quantitative and qualitative phases of the study. 2.1.4. Describe the mixed sampling scheme (i.e., concurrent–identical, concurrent–parallel, concurrent–nested, concurrent–multilevel, sequential–identical, sequential–parallel, sequential–nested, and sequential–multilevel). 2.1.5. Clarify the type of generalization to be made (i.e., statistical generalization, analytic generalization, and case-to-case transfer) and link it to the selected sampling design, sampling scheme, and sample size(s). 2.2.1. Outline the mixed research design. 2.2.2. Specify the quantitative research design (i.e., historical, descriptive, correlational, causal–comparative/quasi-experimental, and experimental). 2.2.3. Specify the qualitative research design (e.g., biography, ethnographic, auto-ethnography, oral history, phenomenological, case study, grounded theory)	Pages 4-5
Research Implementation 3.1.1. Outline the mixed data collection strategy. 3.1.2. Present information about all quantitative and qualitative instruments and the process of administration. 3.2.1. Outline the mixed data collection strategy (i.e., data reduction, data display, data transformation, data correlation, data consolidation, data comparison, and data integration).	Pages 5.6.7 Pages 24-26

3.2.2. Provide relevant descriptive and inferential statistics for each statistical analysis. 3.2.3. Discuss the extent to which the assumptions (e.g., normality, independence, equality of variances) that underlie the analyses were met, as well as any observations that might have distorted the findings (e.g., missing data, outliers). 3.2.4. Specify the statistical software used. 3.2.5. Specify where the responsibility or authority for the creation of categories resided (i.e., participants, programs, investigative, literature, or interpretive), what the grounds were on which one could justify the existence of a given set of categories (i.e., external, rational, referential, empirical, technical, or participative), what was the source of the name used to identify a given category (i.e., participants, programs, investigative, literature, or interpretive), and at what point during the research process the categories were specified (i.e., a priori, a posteriori, or iterative)	Page 5.7
3.2.6. Specify the name of the technique used to analyze the qualitative data (e.g., content analysis method of constant comparison, discourse analysis, componential analysis, keywords in context, analytic induction, word count, domain analysis, taxonomic analysis). 3.2.7. Specify the qualitative software used. 3.3.1. Discuss the threats to internal validity, external validity, and measurement validity and outline the steps taken to address each of these threats to internal validity, external validity, and measurement validity. 3.3.2. Discuss the threats to trustworthiness, credibility, dependability, authenticity, verification, plausibility, applicability, confirmability, and/or transferability of data and outline all verification procedures used. 3.3.3. Discuss mixed research legitimation types (i.e., sample integration legitimation, insider–outsider legitimation, weakness minimization legitimation, sequential legitimation, conversion legitimation, paradigmatic mixing legitimation, commensurability legitimation, multiple validities legitimation, and political legitimation).	Page 5-7, 28-29
3.4.1. Interpret relevant types of significance of the quantitative findings (i.e., statistical significance, practical significance, clinical significance, and economic significance). 3.4.2. Conduct post hoc power analysis for all statistically non-significant findings. 3.4.3. Interpret the significance (i.e., meaning) of qualitative findings.	Page 18-23, Not applicable. Page 10-17,

3.4.4. Discuss criteria for evaluating findings in mixed research studies (e.g., within-design consistency, conceptual consistency, interpretive agreement, interpretive distinctiveness, design suitability, design fidelity, analytic adequacy, interpretive consistency, theoretical consistency, integrative efficacy).	Page 25-26
3.5.1. Describe all steps of the mixed research process.	Throughout paper.
3.5.2. Describe the context in which the mixed research study took place.	Page 5-6
3.5.3. Ensure that the mixed research report is accurate and complete; does not distort differences within and among individuals and groups; is free from plagiarism or misrepresentation of the ideas and conceptualizations of other scholars; and contains findings that are adequately accessible for reanalysis, further analysis, verification, or replication.	Throughout paper.
3.5.4. Present all ethical considerations that were addressed in the study (e.g., informed consent, confidentiality, incentives, funding sources, potential conflicts of interest, biases).	Page 5-6 and page 33
3.5.5. Specify study approval in accordance with an institutional review board either in the report or in the cover letter submitted to the editor.	Covering letter to the editor
3.5.3. Present recommendations for future research that culminate in a validation, replication, or extension of the underlying study.	Page 30

1. Leech NL, Onwuegbuzi AJ. Guidelines for Conducting and Reporting Mixed Research in the Field of Counseling and Beyond. Journal of Counseling & Development. 2010;88:61-9.

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Investigating primary health care practitioners' barriers and enablers to referral of patients with COPD to Pulmonary Rehabilitation: a mixed methods study using the Theoretical Domains Framework.

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Title

Investigating primary health care practitioners' barriers and enablers to referral of patients with COPD to Pulmonary Rehabilitation: a mixed methods study using the Theoretical Domains Framework.

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Key words

Chronic Obstructive Pulmonary Disease (COPD), Pulmonary Rehabilitation (PR), Primary Care, Theoretical Domains Framework (TDF). Mixed methods research.

List of Abbreviations

PR – Pulmonary Rehabilitation
COPD – Chronic Obstructive Pulmonary Disease
PHCP – Primary Health Care Practitioner
TDF – Theoretical Domains Framework

Word Count 4,268

Abstract

Objectives
Pulmonary rehabilitation is a highly effective, recommended intervention for patients with COPD. Using behavioural theory to understand why referral remains low enables the development of targeted interventions in order to improve future PR referral.

Methods
We undertook a multiphase sequential mixed methods study to investigate referral practices of Primary Health Care Practitioners (PHCPs) in the United Kingdom (UK). In phase 1, semi-structured interviews were undertaken. Content analysis was used to map themes to the Theoretical Domains Framework (TDF) and a 54-item TDF-based questionnaire was developed.

In Phase 2 we distributed the questionnaire to a larger PHCP population. We used descriptive analyses to identify barriers and enablers, and key TDF domains. Mixing of data occurred at two points; instrument design and interpretation.

Results

19 PHCP took part in interviews and 233 responded to the survey. Integrated results revealed that PHCPs with a post qualifying respiratory qualification (154/241; 63.9%) referred more frequently (91/154; 59.1%) than those without (28/87; 32.2%).

There were more barriers than enablers for referral in all 13 TDF domains. Key barriers included: infrequent engagement from PR provider to referrer, concern around patient's physical ability and access to PR (particularly for those in work), assumed poor patient motivation, no clear practice referrer and few referral opportunities. These mapped to domains: belief about capabilities, social influences, environment, optimism, skills and social and professional role.

Enablers to referral were observed in knowledge, social influences memory and environment domains. Many PHCPs believed in the physical and psychological value of PR. Helpful enablers were out-of-practice support from respiratory interested colleagues, dedicated referral time (annual review) and on-screen referral prompts.

Conclusions

Referral to PR is complex. Barriers outweighed enablers. Aligning these findings to behaviour change techniques will identify interventions to overcome barriers and strengthen enablers, thereby increasing referral of COPD patients to PR.

Strengths and limitations of this study

1: This is the first mixed methods study to use the Theoretical Domains Framework to identify barriers and enablers to pulmonary rehabilitation referral from a primary health care practitioner perspective.

2: The utilisation and combination of two differing research paradigms in this exploratory sequential approach offers novel and detailed insights through combined research lenses which encompass multiple perspectives.

3: Many geographical regions across the United Kingdom are represented and include a diverse range of primary healthcare practitioners.

4: A combination of participant recruitment approaches have been used to reduce potential sample and selection biases.

5: Generalisability of the overall findings are limited by the inability to calculate distribution and therefore response rates.

Background

Pulmonary Rehabilitation (PR) is a low cost, high value, internationally recommended intervention for COPD patients which is effective in improving exercise capacity, reducing the impact of symptoms and improving prognosis (1, 2) . It is a structured multidisciplinary intervention combining individualised exercise with disease-related education (3). Despite the clear evidence of its effectiveness, the proportion of COPD patients receiving PR is persistently low worldwide (4, 5). Our previously published inductive qualitative paper presented the experiences of primary health care practitioners (PHCPs) as key potential referrers to PR (6). We found that there was a generalised awareness of PR, but little detailed knowledge of either the programme or the clinical benefits. Relationships with PR providers were limited, but considered important. Patient characteristics, rather than clinical need, influenced referral offers and referrers frequently believed patients to be poorly motivated. PR was most commonly offered during times of disease stability (usually at COPD annual review) and ease of the referral process and financial incentives positively influenced referral. In summary, referrers reported many barriers but few enablers, which collectively resulted in infrequent discussions about PR and associated referrals.

However, in order to aid the development of appropriate interventions to improve referral rates it is important to establish the generalisability and relative importance of these findings within a broader population of PHCPs. Furthermore, applying theory to identify the psychological and structural drivers that influence behaviour (7, 8) may offer new insights to shape interventions (9).

The Theoretical Domains Framework (TDF) is a well-recognised approach which was derived from a synthesis of behaviour change theories (10), and examines the processes that

influence behaviour (11). When applied, it offers explanations for behaviours, highlighting reasons that may inhibit or promote (12, 13) implementation of practice-based change (12).

Using mixed methods, and applying the TDF we sought to assess and explain the reasons for low PR referral by primary health care professionals (PHCPs) for patients with COPD. The aim of our multiphase design was to inform the development of theory informed interventions to improve PR referral rates from primary care in future.

Methods

We used a multiphase sequential design defined by two separate phases (figure 1). The cognitive and practical experiences of PHCP when considering and undertaking referral for patients with COPD were initially explored using a deductive approach by applying the TDF to data from our previously collected qualitative interviews. These findings informed a second quantitative phase, where we tested themes for generalisability using a nationwide survey of PHCP, to highlight the most relevant factors influencing referral. (14-16).

Figure 1 Multiphase sequential research design

Both data sets retained independent value and meaning, but were connected at two time points: 1) where the qualitative data was used to construct the questionnaire and 2) where phase 1 and 2 results were integrated to inform interpretation. The multiphase sequential mixed methods design therefore achieves both methodological and content integration (15, 16).

Patient and Public Involvement

There has been no public and/or patient involvement in this study.

Phase 1 Application of TDF to qualitative interview data.

We re-analysed data from our previously published inductive qualitative study (6) in which 19 PHCPs from two differing geographical regions across Central and East of England were

recruited and interviewed to thematic saturation using a pre-designed topic guide. A deductive approach using content analysis (17) was used for re-analysis of the data in order to align the results to the TDF and to offer new insights.

The interview topic guide (Additional file 1) was mapped to the Capability Opportunity Motivation-Behaviour model (COM-B), a model that highlights three critical prerequisites for behaviour change (18). This model was adopted rather than the TDF to guide interviews primarily because of the practical need to reduce interview length without compromising its aim. COM-B is very closely aligned to the TDF and has been utilised as a topic guide and mapped to the TDF in a similar health care professional study (19).

Analysis

All interview transcripts were managed using NVivo v12. Barriers and enablers emerging from the interviews via content analysis were mapped to the relevant TDF domain, initially using construct labelling (10, 20) (Additional File 2). Utterances were coded once to the key TDF construct which then determined TDF domain alignment. JW undertook the initial coding then 5 transcripts were randomly allocated and distributed throughout the team (RJ, PA, and SG) and independent TDF coding occurred, followed by frequent collaborative team discussion to ensure agreement with the coding. Queries were discussed with a behavioural expert (IV).

Phase 2 Quantitative Methodology

Study Design – Cross sectional survey.

PHCPs were recruited via two main methods. Initially an invitation was included in a fortnightly newsletter emailed to members of the Primary Care Respiratory Society (PCRS). The survey was additionally distributed and shared by PCRS via their organisational Twitter and Facebook accounts. Social media distribution of the survey was further increased by individual and other organisational sharing, including the Facebook accounts of Advanced Practice UK and General Practice Nurse UK. A link for questionnaire completion was provided to the platform 'Online Survey' (21). This was open between April and December 2019. To increase participation, responders were invited to opt in to a prize draw to win an I-pad.

Simultaneously, paper versions of the questionnaire were distributed at 6 UK conferences between March and November 2019 to attending PHCPs (predominately by hand by JW, and using 'in-conference bag' distribution at one event). Upon self-completion, questionnaires were placed by participants in a locked ballot box and an optional token of appreciation was offered. Paper questionnaires were manually entered onto 'Online survey' by JW.

As this was exploratory research, no *a priori* sample size calculations were performed. A pragmatic approach to study closure was adopted, this being online availability for a period of 8 months, distribution of the questionnaire at several appropriate PHCP targeted events, and that a reasonable range of PHCP had responded.

Methodology– Instrument Design

The cross-sectional survey (Additional file 3), collected (1) individual socio-demographic data, (2) current referral experiences, using TDF-based Likert scale questions (n=54) and (3) any new or complementary issues which may not have been previously mentioned, using an optional open question (22).

Socio-demographic data

These included questions on geographical location of practice, job title, post-qualifying respiratory education and estimated frequency of PR referrals, using questions with pre-specified options.

Psychometric data

Barriers and enablers for PR referral identified from the phase 1 qualitative findings were converted into belief statements (20), including some that sought to test direct understanding. All questions were generated and aligned to the TDF by the coder (JW) and validated by other team coders (RJ), including a TDF expert (IV). 54 closed, fully labelled 5-point, Likert scale questions/belief statements were included with responses ranging from 'strongly disagree' to 'strongly agree' and a mid-point rating. Some statements were reversed as an opposite belief to that frequently reported in the phase 1 data. These design elements were purposely selected to improve reliability and validity (23).

The final survey mapped the 54 belief statements and open question section to 12 out of 14 theoretical domains ('emotion' and 'behavioural regulation' was excluded, given its low mapping in phase 1 results). Two rounds of survey piloting were undertaken with five practice nurses and the questionnaire refined to ensure question clarity and clearer completion instructions.

Analysis

All data were exported into an excel spreadsheet and STATAv16 used to conduct simple descriptive statistics (frequencies and percentages), dichotomising into Agree/Strongly Agree *vs* the remaining options. Free text that directly related to barriers and enablers of referral practice was content-mapped to the TDF and thematic analysis applied (24).

Results: Phase 2

Response rates.

Paper surveys (>1100) were distributed across 6 UK primary care focused events which were attended by a variety of PHCPs. 154 (~14%) were returned and 134/154 (83%) completed the survey sufficiently and were included. Online, it is unknown how many potential practitioners read the survey invitation, therefore participation rates could not be calculated. 123 participants started the online survey, but only 99 (80.5%) completed it and were included in the analysis.

Full details of the paper survey distribution and return rates can be found in additional file 1.

Description of participants

Table 1 presents the socio-demographic characteristics for participants in the phase 2 quantitative (n=233) studies. Participants characteristics for phase 1 (qualitative) are available in the previously published paper (6)

In contrast to the qualitative study where 6/19 (32%) were GPs, the survey respondents were predominantly female nurses. Nurse respondents were similarly distributed across both conference and online groups (110/134, 82.1%; and 76/99, 76.9% respectively) and

258 responders from both sources had similar time working in practice. However, respondents
259 recruited through conferences, compared to those who responded online, tended to be
260 younger (28% < 40 years of age), more likely to be practice nurses rather than other types of
261 professionals, but were less likely to have respiratory qualifications, to see COPD patients or
262 to refer them to PR.
263
264 Table 1 Baseline demographics of phase 2 participants

		Phase 2 Survey (n=233)		
		Conference (n=134) (%) (%)	**Online (n=99) (%)**	**Total (n=233)**
Primary Health Care Practitioner Role	General Practitioner (GP)	18 (13.4)	11 (11.1)	29 (12.5)
	Advanced Nurse Practitioner (ANP)	25 (18.7)	32 (32.3)	57 (24.5)
	Practice Nurse (PN)	85 (63.4)	44 (44.5)	129 (55.4)
	Emergency Care Practitioner (ECP)	1 (0.8)	1 (1)	2(0.9)
	Pharmacist	-	4 (4)	4 (1.7)
	Health Care Assistant (HCA)	-	1 (1)	1 (0.4)
	Other	5 (3.7)	6 (6.1)	11 (4.7))
	Total responses	134/134 (100)	99/99 (100)	233/233 (100)
Sex	Female	115 (91.3)	92 (92.9)	207 (92)
	Male	11 (8.7)	7 (7.1)	18 (8)
	Total responses	126/134 (94)	99/99 (100)	225/233 (96.6)
Age (years)	18-29	5 (3.8)	2 (2)	7 (3.0)
	30-39	32 (24)	11 (11.1)	43 (18.5)
	40-49	36 (27.1)	40 (40.4)	76 (32.8)
	50-59	49 (36.8)	40 (40.4)	89 (38.4)
	60 +	11 (8.3)	6 (6.1)	17(7.3)
	Total responses	133/134 (99.3)	99/99 (100)	232/233(99.6)
Ethnicity	White British	112 (84.2)	87 (87.9)	199 (85.7)
	White other	8 (6)	4 (4.1)	12 (5.2)
	Asian/Asian British	7 (5.3)	3 (3)	10 (4.3)
	Mixed Multiple Ethnic Groups	1 (0.7)	2 (2)	3 (1.3)
	Black/African/Caribbean/Black British	2 (1.4)	-	2 (0.9)
	Other ethnic group	3 (2.4)	3 (3)	6 (2.6)
	Total responses	133/134 (99.3)	99/99 (100)	232/233(99.6)
Practice Geographical Location	Scotland	1 (0.8)	3 (3)	4 (1.7)
	England North East and West	31 (23.6)	15 (15.1)	46 (20)
	Yorkshire and the Humber	8 (6.1)	6 (6.1)	14 (6)
	Midlands (East and West)	20 (15.3)	16 (16.1)	36 (15.8)
	East of England	23 (17.5)	18 (18.2)	41 (17.8)
	Wales	31 (23.6)	-	31 (13.5)
	London	3 (2.4)	6 (6.1)	9 (3.9)
	South (East and West)	14 (10.7)	35 (35.4)	49 (21.3)
	Total responses	131/134 (97.8)	99/99 (100)	230/233(98.7)
Years in General Practice	< 5	39 (29.9)	23 (23.2)	62 (27)
	6- 10	26 (19.8)	25 (25.3)	51 (22.2)
	11-15	18 (13.7)	18 (18.2)	36 (15.7)
	16-20	22 (16.8)	14 (14.1)	36 (15.7)
	21 +	26 (19.8)	19 (19.2)	45 (19.4)
	Total responses	131/134 (97.8)	99/99 (100)	230/233(98.7)
Currently see COPD patients	Acute Management	9 (6.7)	5 (5)	14 (6)
	Chronic Management	30 (22.6)	26 (26.3)	56 (24)
	Acute and Chronic management	81 (60.9)	67 (67.6)	148 (64)
	Don't see COPD patients	13 (9.8)	1 (1)	14 (6)

	Total responses	133/134 (99.3)	99/99 (100)	232/233(99.6)
CPD Respiratory Qualifications*	None	62 (46.3)	19 (19.2)	81 (34.8)
	COPD Diploma	28 (20.9)	50 (50.5)	78 (33.5)
	Asthma Diploma	38 (28.4)	52 (50.5)	90 (38.6)
	ARTP Spiro	34 (25.4)	40 (40.4)	74 (31.8)
	Other	16 (11.9)	26 (26.3)	42 (18)
	> one qualification	32 (23.9)	51 (51.5)	83 (35.6)
	Total responses	210	238	448
Reported PR referral practice	Yes (frequency not specified)	-	11 (11.1)	11 (4.7)
	Weekly	16 (12)	32 (32.3)	48 (20.7)
	Monthly	40 (30.1)	21 (21.2)	61 (26.3)
	< Monthly	43 (32.3)	29 (29.3)	72 (31)
	None	34 (25.6)	6 (6.1)	40 (17.3)
	Total	133/134 (99.3)	99/99 (100)	232/233(99.6)

Referral to PR by type of healthcare professional

Overall, 109 (49.1%) reported being frequent referrers to PR, with GPs being less likely to refer and other professions including emergency care practitioners and nurse practitioners and ANPs more likely to refer. Referral was also higher among those with one or more continuous practice development (CPD) respiratory qualifications. However, this may be partly related to such qualification being higher among ANPs (82.5% (47/57)) and other grouped professions (58.8% (10/17)) than among GPs (17.9% (5/28)). More than 10 years spent in general practice appeared to marginally increase referral frequency (60.7%; 51.8%).

Table 2 PHCP referral practice*

	Frequent Referral n (%) (weekly or monthly) Total n=109	**Infrequent referral n (%) (>monthly or no referral) Total n=113**
Staff type		
GP (n=28)	10 (35.7)	18 (64.3)
PN (n=120)	57 (47.5)	63 (52.5)
ANP (n=57)	32 (56.1)	25 (43.9)
Other (ECP/NP/Pharm/HCA) (n=17)	10 (58.8)	7 (41.2)
CPD Respiratory Qualification	84 (77.1)	59 (52.2)
Years in Practice > 10 years**	65/107 (60.7)	58/112 (51.8)

*11/99 online PHCPs specified that they referred to PR but did not specify referral frequency and were removed from this analysis.
** 107/109 and 112/113 reported time spent in general practice

40/233 (17.2%) responding PHCPs reported never referring to PR, with the largest group being practice nurses (29/40; 72.5%). 33 of 40 PHCPs offered a variety of reasons for non-referral including; not considering it to be part of their role, not seeing COPD patients or not knowing they could refer (12/33; 36.4%). Others reported it was undertaken by other respiratory specialist/interested health care professionals across primary and secondary care

settings (12/33; 36.4%). Further reported reasons were unsure how to and/or a lack of training (5/33; 15.1%), uncertainty about local service provision (3/33; 9.1%) and 1/33 (3.0%) reported belief that patients were not interested.

Phase 1 Results: TDF analysis of the qualitative interviews

Table 3 shows the referral behaviour of PHCPs mapped to all 14 TDF domains. The most frequently mapped domain was social and professional role (n=287 times) whilst the least mapped was behavioural regulation (n=4).

299 Table 3: Phase 1 Mapping of barriers and enablers for referral to TDF domains

300

TDF Domain (construct mapping frequency)	Content mapping (n)	Key points	Evidence supporting
1.Social and Professional Role (A coherent set of behaviours and displayed personal qualities of an individual in a social or work setting)	(n=289)	Referral was considered everyone's role, however it was considered best undertaken by the PHCP during disease stability and at annual review. It was often considered to be the practice nurses' role, but also respiratory-interested others. Most PHCPs considered it their duty of care to motivate patients. Only 1 of 19 PHCPs described implementing practice leadership to improve PR awareness and/or referral.	*It is largely the nurses' job to see stable COPD patients at an annual review and that is the most appropriate time to refer to pulmonary rehabilitation, not during an acute exacerbation' –GP5* *No, I think it's everybody's role, I mean I'm not sure about my non-respiratory colleagues.* PN2 *So we've put forward a proper business case for it. (Local PR service).* GP4
2.Knowledge (An awareness of the existence of something)	(n=256)	17 of 19 PHCPs knew of the existence of PR and a generalised understanding of its purpose. PR Knowledge was reported to be gained through post qualification education and networking events. Local PR knowledge such as programme timing, waiting list (if any), and availability of patient transport, was often unknown and were described as inhibitors to referral discussions. The referral criteria Medical Research Council (MRC) dyspnoea Score ≥3 was frequently cited as a referral prompt, although some PHCPs wanted to refer patients with MRC scores of 2 and felt unable to.	*I think it's a fundamental treatment and I think it's better than drugs.* PN7 *Do you currently refer to PR? P -I wouldn't know where.* GP2 *I don't know how to describe pulmonary rehab to a patient.* GP3 *I just feel that we don't know enough about the program to confidently hand on your heart sell it.* PN1 *'We've also got the barrier of we can only refer if their MRC is 3 or 4 or 5'* PN5
3. Environment (Any circumstance of a person's situation or environment that discourages or encourages the development of skills and abilities,	(n=195)	PR referral was often considered inappropriate in non-COPD focused consultations or when a patient was consulting for an acute exacerbation. Clinical time constraints were often described as inhibiting referral, although annual review considered appropriate time	*I think in our role when you're treating potentially acutely unwell people in a really limited time span then it's, it is realistically going to be hard to cover everything, really hard.* ANP2

independence, social competence, and adaptive behaviour)		because of its clinical focus, template design and longer consultation time. PHCPs often stated little PR promotional material was available in practice for patients or staff; there were however mixed views on the potential value of this. 3 practices had initiated an in-practice 12 weekly, 1 hour generic exercise group, this appeared to be seen as equivalent to PR by 1 PN.	*On the annual review well I follow the template and when I get to the pulmonary rehab I mention it then and I say, 'Would you like to go?'* PN3 *It would be useful for our local organisation I think to give us some little leaflets about what they do so we can give that to patients about the local service* ANP4 *I'm not against a leaflet but have you seen how many posters and leaflets we have on our walls?* GP2
4.Belief about capabilities (Acceptance of the truth, reality, or validity about an ability, talent, or facility that a person can put to constructive use)	(n=141)	Individual PHCP PR referral confidence varied, with particular uncertainty expressed in how to best 'sell PR' and how to motivate un-motivated patients. Although most were confident in reassuring patients that PR would improve breathlessness. PHCPs with positive non-pharmacological and exercise beliefs appeared to have greater confidence in PR benefit and patients' abilities A number of PHCPs described COPD patients as uninterested in improving their health and some PHCPs emphasised patients needed to be committed to PR. Whilst some PHCPs described 'knowing' which patients would accept referral, others described undertaking subjective patient assessment and expressed concerns about patients' exercise capability in the presence of breathlessness. For patients receiving oxygen therapy there was much uncertainty of the benefit of PR and an assumption that Oxygen/secondary care teams would have previously offered this. Most PHCPs considered key environmental factors such as session timing, venue accessibility, patient financial hardship, as barriers for most patients. Patients in work, or	*I would need to feel confident, before I speak to this patient about it.* ANP4 *I quite like... Non-medicinal treatment…think if you're excited by it then it's easier for patients to get excited by it as well.* GP4 *They are also very very clear that there not going to take anyone on their course unless there is 100% commitment at the beginning that they are going to complete the course.* ANP1 *You look at the ones that you think would more likely go.* ANP4 *It's really basically where I see a need, where I see they can benefit – ANP1* *If the patients already on oxygen therapy, then it's likely that they've already been seen by them.* HCA *The main stumbling block is that you come across is " I'm not going every week for x number of weeks, I can't afford it, I haven't got that much time, how do you expect me to get there ….not a huge number of our patients drive.* GP4

		those able to take the dog for a walk/wearing walking boots were considered 'too well' for PR.	*There's some patients that I would like to refer but they can't go because of work commitments.* PN3 *'It's quite surprising that some patients are still working at odd jobs and things like that and keep them very active. So, for those patients it's not so important.'* PN3
5.Memory (Inc: Decision making) (The ability to retain information, focus selectively on aspects of the environment and choose between two or more alternatives)	(n= 118)	Some PHCPs reported forgetting to refer patients to PR, however, embedded system reminders often found in COPD review templates or on-screen prompts were cited as important for most PHCPs. Patient behaviour and clinical presentation altered decision making processes for some PHCPs for example not referring current smokers, or remembering PR in light of increasing COPD symptom burden and disease deterioration, whilst earlier concerns for patient capability and commitment became less apparent.	*I do need a reminders because my head's full, so as I say, I don't want to tick boxes but I do need a prompt.'* PN7 *That's something that we do, so we have a prompt that pops up saying has this patient been referred to pulmonary rehab.* GP5 *I think I go through phases, I'll do it really well for a while and somebody has motivated me and then I'll forget that and do something else.* PN7 *Breathlessness and exacerbations, I think, would be the key factors.* GP3
6.Optimism (The confidence that things will happen for the best or that desired goals will be attained)	(n=110)	PHCPs frequently reported that patients did not want to attend PR, citing disease stigma and lack of activation as underlying reasons. Negative patient responses appeared to dampen PHCPs optimism and reduce subsequent referral offers. Positive patient experience however had the opposite effect. Positive and negative perceptions of PR providers were also reported on the basis of service quality and frequency of referral acceptance, this appeared to influence referral behaviour.	*The first thing you think, 'Are they going to do it?* ANP4 *Patients don't want it.* PN5 *Even if you then said what the evidence was and how you could improve, it's – I think that group of people are really difficult to engage* .GP3 *If they're negative anyway everything you suggest they sort of have an answer, 'Oh no that won't work.* PN4 *The longer the wait time, the less likely they are to turn up. HCA* *I don't think it's the greatest service, it does have an impact because I'm not going to tell my patients to go.* PN7

7.Belief about consequences (Acceptance of the truth, reality, or validity about outcomes of a behaviour in a given situation)	(n=107)	There was a general sense that PR is positive with many health and psychological benefits, but beliefs captured in other domains impacted on PHCP belief about consequences of referral offer. A small number of PHCPs expressed concern that PR might worsen patient's depression and/or anxiety, particularly for those socially isolated.	*I've seen patients that have been… their lives have been transformed in the first year.* PN7 *Might have prevented the exacerbation if they'd gone* PN5 *I will say that when I'm talking to patients, say it's better than drugs, but I still get a closed reaction.* PN7 *If we can improve patient's breathing they're less likely to get anxious, that makes them less likely to dial 999 or likely to do something about it. And perhaps use their rescue packs more appropriately.* ANP4 *I wouldn't want to mention it if it ended up being that I'm saying there's this really good helpful programme but actually if she's so effected by her disease that she doesn't leave the house then I wouldn't want to have mentioned it and then not for her not to be able to go.* ANP2
8.Social Influences (Those interpersonal processes that can cause individuals to change their thoughts, feelings, or behaviours)	(n=84)	Out of practice engagement from PR providers and PR advocates were important in increasing overall awareness and positively influencing referral behaviour. Almost all PHCPs described little to no engagement from providers themselves, and described not knowing what had happened to completed referrals. PHCPs also reported that positive patient PR experiences positively influenced PHCPs referral behaviour and that family can be influential, yet patients rarely ask for PR. PHCPs described a need to increase PR's profile publicly and for it to be marketed similarly to pharmacological treatments. The name PR itself was considered by some PHCPs to be a negative influence as 'rehab' was deemed to have undesirable connotations.	*Our referral rate has gone up a lot since the respiratory MDT's because every single one of those patients has subsequently had a referral*. GP4 *At the moment I wouldn't know how many people we refer, is that referral going up, Nobodies giving us feedback from the rehab team about how we are doing as a surgery.* PN1 *If patients that have been to it you know express a positive experience that is something you can share with other people that you are trying to refer.* GP1 *I asked him to talk to his wife, because I knew she'd want him to go, because I know her through a different channel, and erm... he's come back and said 'Ooo I'll give it a shot.* PN5

			Nobody has picked up a leaflet and walked in with it and said can you refer me, nobody has. ANP1
9.Skills (An ability or proficiency acquired through practice)	(n=79)	The physical act of referring patients to PR were described as largely straightforward by most PHCPs, although there was no standardised process across the 2 regions. Most undertook this action independently, although there were descriptions of practice administrators helping. However, frequency of referral to PR when described in interviews, was far lower than that which was documented on the returned research interest form.	*Do you currently refer people to pulmonary rehab? Some, some.* PN7 *I've been at this practice for nearly three years now and it's sort of something that falls really far down on your list of things that you do on your COPD review, so it's always the last thing that you come to.* GP4 *It's very easy. It's a form erm it's a just a single sheet.* PN2 *Quicker, easier referral, much easier referral method* PN7
10.Reinforcement (Increasing the probability of a response by arranging a dependent relationship, or contingency, between the response and a given stimulus)	(n=59)	There appeared to be no direct sanctions for non-referral of patients, although practice financial rewards in one region appeared to enhance awareness and referral. Outside of these practices there was a suggestion that financial incentives would be advantageous, additionally calculating health cost benefit for PR attendance was suggested as potential enabler. Additionally reinforcements such as those offered by social influences and patients were also described to be valuable.	*We've got this thing called A** that we're doing for, you know it was the QOF before, so like A** has taken over that so I think because of the A** the doctor who is the lead A** leader he discusses that a lot because of course you get points, you still get the points for it like QOF. So the more we refer is the more points we get so there's an incentive there for the practice.* PN6 *Yeah if they did something on the BBC or something they might all be in the next day saying, 'Oh I wanna do that'.* PN4 *If you spent 5 minutes with somebody then at the end of that they agreed to go and then they attended, then you would be motivated to do it again.* GP5
11.Goals (Mental representations of outcomes or 'end states' that an individual wants to achieve)	(n=47)	Referral to PR was a low-level goal for most PHCPs, but one that varied by consultation type and was not considered during an acute exacerbation review. However, referral appeared to become a goal in the presence of worsening patient symptoms.	*As a practice, when we do the acute exacerbation we're pretty much focus on the acute exacerbation.* GP4 *I refer a few to pulmonary rehab but I don't do as many as I feel I should.* PN7

		Some PHCPs described wanting to refer more patients and learning strategies to improve patient acceptance, but described frequent discord between PHCP and patient goals which PHCPs found challenging. No PHCPs discussed set practice PR referral targets although one GP reported plans to set up a programme geographically closer to practice (captured as leadership in the domain social & professional.)	*She was more receptive because she'd had a few flares up, not after the first one but because she's had a few. And I think that makes them more receptive to doing that sort of thing*. ANP4 *One hand I'm wanting them to engage with the disease process so that actually they've got more skills to self-manage and that's going to actually keep them much better for the rest if their whole of their life, on the other hand they don't want to be classified as ill.* ANP1 *It would help me in trying to find out why she didn't go because I would challenge her on it and try and get her to go again and give it another go and that would help me in.* ANP4
12.Intentions (A conscious decision to perform a behaviour or a resolve to act in a certain way)	(n=39)	Some PHCPs have described adopting patient-aimed strategies that included persistence and warnings against overreliance and/or possible reduced effectiveness of pharmacological treatments in an effort to move patients to a state ready for PR referral. There also appeared to be an understanding that acceptance for many patients takes time.	*I said you know you've used those rescue packs a lot you know if we could get your breathing a bit better, perhaps you wouldn't be so bad….., and she said, alright then I'll see, do the referral.* ANP4 *How would you feel about something that's not medicine based but will probably help you as much as the inhalers that we've put you on, she was suddenly very interested in.* GP4 *I look for that chink of interest and then I'll try and worm my way in then.* PN7 *He was very adamant that he didn't want to go, then I gave him the booklet*. PN5
13.Emotion (A complex reaction pattern, involving experiential, behavioural, and physiological elements, by which the individual attempts to deal with a personally significant matter or event)	(n=6)	PHCPs emotion was rarely discussed although some said they felt annoyed with providers if a referral had been rejected. There were high levels of empathy towards patients particularly amongst nurses; a small number described not	*Most of our patients are reasonably trusting and say well you seem quite excited by it so shall we give it a try.* GP4 *They're gonna meet all these people they don't know and be told to lift this walk here, do that and they're frightened, its... I'd be terrified.* PN5

		wanting to offer the hope of PR to patients and for PR providers to reject referral, this appeared to be a particular concern for patients with high disease burden.	*I just don't want to raise – if you raise patients' hopes and say – and offer it, then it can make them – you know, if they're already depressed because of the COPD, it could just make the depression worse you know, so I don't want to impact on their mental wellbeing. ANP1*
14.Behavioural regulation (Anything aimed at managing or changing objectively observed or measured actions)	(n=4)	Some PHCPs saw events such as hospital admissions/out-patient appointments as good opportunities for patients to change behaviours but for staff in those settings to instigate referral. PHCP personal behavioural regulation was low, many did not know how any they had referred or what, post referral, the patient's journey had become. One participant described the research interview as helpful in allowing them to consider how to change their referral approach, but most PHCPs did not vocalise intentions to change or modify current or future PR referral behaviours.	*I don't know how much is done in secondary care, but very often when stuff, when you've been in anywhere near secondary care people really its often quite a sit up moment, gosh this is serious enough for me to have to go to hospital, even if it an outpatient appointment.* ANP1 *This is one of your treatment choices' and perhaps I need to change, thinking about it, my approach in – er, how I word it.* ANP4 *It's trying to make it a priority.* ANP4

Phase 2. Questionnaire results: Referral practice beliefs.

Table 4 presents the number and proportion of PHCPs that agreed or strongly agreed with each belief statement by frequency of referral.

311 Table 4 Results of TDF belief statements by referral frequency

TDF Domain	TDF Questions (n=54)	Frequent referral n=109 (%) (weekly/monthly)	Infrequent referral n=113(%) (>monthly or no referral)	Total n=222(%)
1.Knowledge	I am aware of the content of Pulmonary Rehabilitation (PR) Programmes *	97/109 (89.0)	72/113(63.7)	169/222 (76.1)
	I am aware of PR programme objectives. *	99/109 (90.8)	75/113 (66.4)	174/222 (78.4)
	I am unsure of the evidence base for PR	18/109(16.5)	30/113 (26.5)	49/222(21.6)
	I know where geographically my local PR programme is delivered*	92/109 (84.4)	70/113(61.9)	162/222 (73.0)
	I know when it is appropriate to refer a patient with COPD to PR *	106/109 (97.3)	74/113 (65.5)	180/222 (81.1)
	I can answer questions patients have about PR*	88/109 (80.7)	60/113 (53.1)	148/222 (66.7)
	I know how to contact my local PR provider *	91/109(83.2)	68/113 (60.2)	159/222 (71.6)
2.Skill	It is easy to refer a patient to PR*	87/109 (80.0)	48/113 (42.5)	135/222 (60.8)
3.Social & Professional Role	Referral to PR is the practice nurse role	63/109 (57.8)	45/113 (39.8)	108/222(48.6)
	Other General Practice staff in my practice (excluding Practice Nurse) refer patients to PR	52/109(47.7)	63/113(55.8)	115/222 (51.8)
	I believe in encouraging patients to attend PR	109/109 (100)	104/112 (92.9)	213/221 (96.4)
4.Environment	Resources about PR i.e written information) are readily available	39/109 (35.7)	25/112 (22.3)	64/221 (29.0)
	There is not enough time in practice to refer	12/109 (11.0)	22/113 (19.5)	34/222(15.3)
5.Social Influences	My local PR providers regularly engage with me	31/109 (28.4)	17/113 (15.0)	48/222 (22.6)

	PR is something that patients ask for	3/109 (2.8)	8/112 (7.1)	11/221 (5.0)
	There are good relationships in practice with PR providers	44/109 (40.4)	28/112 (25.0)	72/221 (32.6)
	PR providers are good at communicating outcomes of referrals I have made	39/109 (35.8)	25/112 (22.3)	64/221 (29.0)
6.Optimism (including pessimism)	I am confident my local PR provider offers a good service for my patients.*	81/109 (74.3)	52/113 (46.0)	135/222 (60.8)
	I don't believe patients will attend PR after I have referred	16/109 (14.7)	16/113(14.2)	32/222(14.4)
	Patients who smoke are not motivated to take part in PR	7/109 (6.4)	7/113 (6.2)	14/222 (6.3)
	Patients who live alone won't like to take part in group PR	5/109 (4.6)	2/113 (1.8)	7/222 (3.2)
	Patients are motivated to attend PR	23/109 (21.6)	30/111 (27.0)	53/219 (24.2)
7.Belief about Capabilities (self)	I am confident in my ability to encourage patients to attend PR, even when they are not motivated	91/109(83.5)	73/113 (67.6)	164/222 (73.9)
	I do not find it easy to discuss PR with patients.	8/109(7.3)	25/113 (22.1)	36/222(16.2)
Belief about capabilities (patients)	Patients without their own transport won't be able to get to PR	40/109(36.7)	26/113 (23.0)	66/222 (29.7)
	Patients in work are not able to attend PR *	62/109 (56.9)	35/113 (31.0)	97/222 (43.7)
	Patients who use home oxygen are unable to take part in PR	4/109(3.7)	6/113 (5.3)	10/222 (4.5)
8.Belief about consequences	If I keep pushing patients to attend PR this will disadvantage my relationship with them.	10/109 (9.2)	10/112 (8.9)	20/221 (9.0)
	I believe patients may be harmed by taking part In PR	1/109 (0.9)	1/113 (0.9)	2/222(0.9)
	I believe most patients will attend and complete PR following my referral	55/109 (50.4)	47/112 (42.0)	102/221 (46.2)
	PR is not beneficial to patients who are breathless	3/109(2.8)	3/113(2.7)	6/222 (2.7)

	PR is best suited to those patients with worsening breathlessness	29/109 (26.6)	29/112 (25.9)	58/221 (26.2)
	PR is **best** suited to those who have frequent exacerbations	27/109 (24.8)	28/112 (25.0)	55/221 (24.9)
	PR reduces hospital admissions	101/109 (92.7)	97/112 (86.6)	198/221 (89.6)
	PR reduces risk of mortality	85/109 (78.0)	82/112 (73.2)	167/221 (75.6)
	If patients attend PR this will reduce their general practice visits	73/109 (67.0)	78/112 (69.6)	151/221 (68.3)
	PR reduces exacerbations	88/109 (80.7)	84/112 (75.0)	172/221 (77.8)
	PR improves breathlessness	103/109 (94.5)	100/112 (89.3)	203/221 (91.9)
	PR reduces a patient's anxiety and/or depression.	97/108 (89.8)	96/112 (85.7)	193/220 (87.7)
9..Goals	Referring patients to PR is something I have been advised to do*	95/107(88.8)	57/112(50.9)	152/219 (69.4)
	My practice regularly reviews COPD registers to ensure eligible COPD patients are offered PR	51/109 (46.8)	40/113 (35.4)	91/222 (41.0)
	There are set targets within the practice to improve PR referral rates	23/109 (21.1)	21/113 (18.6)	44/222 (19.8)
10. Memory (Inc.Decision Making)	I often forget to refer patients with COPD to PR	3/109 (2.8)	23/113 (20.4)	26/222 (11.7)
	Prompts to refer patients to PR within annual review templates are important reminders for me	72/109 (66.1)	69/112 (61.6)	141/221 (63.8)
	I only refer patients if they have quit smoking	1/109 (0.9)	3/113 (2.7)	4/222 (1.8)
	I only refer patients if they are optimised on their respiratory medication	17/109 (15.6)	12/113 (10.6)	29/222 (13.1)
	PR is most suited to COPD patients who have frequent exacerbations	20/109 (18.3)	20/113 (17.7)	40/221 (18.1)

	The best time to discuss PR referral with patients is when they are stable.	32/109 (29.4)	25/112 (22.3)	57/221 (25.8)
11.Reinforcement	More health care practitioners will discuss PR with patients because of the QoF incentive.	75/109 (68.8)	73/112 (65.2)	148/221 (67.0)
	My practice receives financial incentives for referral to PR (Before April 2019)	6/108 (5.6)	5/113 (4.4)	11/221 (5.0)
	I believe patient attendance to PR will increase because of the QoF Incentive.	41/109 (37.6)	58/112 (51.8)	99/221 (44.8)
	I believe the QoF incentive will not increase patients PR attendance *	29/109 (26.6)	25/112 (2.3)	54/221 (24.4)
	There will be greater awareness of PR within practices because of the new QoF incentives.	84/109 (77.1)	71/112 (63.4)	155/221 (70.1)
12.Intentions	I will refer more patients to PR now there are practice QoF incentives (from April 2019)	30/109 (27.5)	42/112 (37.5)	72/221 (32.6)

*differences in results of >20% between frequent and infrequent referrer

In general, most PHCPs had some PR knowledge (especially the frequent referrers) and understood the beneficial consequences of PR. However, resources, social influences (such as relationship with PR providers) and pessimism about patient motivations were perceived barriers by a high proportion of PHCPs, irrespective of their referral practice.

There were however, differences in domains between frequent and infrequent PR referrers.

The greatest differences were within the 'Knowledge' domain. Frequent referrers most commonly reported agreement with all 7 statements, when compared to the infrequent referrers. For example, 97.3% reported knowing when to refer to PR and 80.7% being able to answer patients' questions versus 65.5% and 53.1% of infrequent referrers.

Further group differences were demonstrated in the 'Skills' domain and 'Beliefs about (PHCP) capabilities', which showed that infrequent referrers were less confident in encouraging unmotivated patients to attend PR (67.6% versus 83.5% of frequent referrers). Reduced confidence amongst infrequent referrers was further reflected within the 'Optimism' domain and belief statement 'I am confident my local provider offers a good service' (46% against 74.3% of frequent referrers). However, over half (56.9%) of frequent referrers felt that patients in work were not able to attend PR, compared to less than a third (31%) of those who referred infrequently.

The remaining belief statements demonstrated greater group similarities than differences. Environment, Social and Professional role: Most respondents felt that there was enough time in practice to refer (84.7%) and believed in encouraging PR attendance (96.4%). Yet promotional information on PR was rarely available in practices (29%). There was no clearly identified PR referrer; less than half (48.6%) felt it was the practice nurse's role and (51.8%) reported other practice staff refer.

Social influences: Frequent referrers were slightly more likely to agree with 3 of the 4 domain belief statements than infrequent referrers. Although, collectively the groups reported both PR provider engagement and referral outcome reporting as low at only 22.6% and 29% respectively. PHCPs also reported patients rarely request referral to PR (5%).

Belief about consequences and Optimism: Most PHCPs agreed that PR offers physical health benefits, including improving breathlessness and reducing hospital admissions (91.9%, 89.6%) respectively. Yet far fewer PHCPs believed patients would attend and complete PR (46.2%), with fewer still agreeing that patients are PR motivated (24.2%).

Memory (decision-making): Only a small number of PHCPs reported forgetting to refer patients to PR (11.7%). COPD annual review templates were reported as helpful referral reminders (63.8%) and 25.8% reported the best time to discuss referral with patients was during COPD stability. Patient characteristics such as disease stability and smoking status do not appear to impede PHCP referral decisions as 98.2% reported referring smokers.

Goals, Reinforcement and Intention: in-practice review of eligible patients was not commonly reported (41%) and only (19.8%) reported in-practice targets to improve referral rates. Practice financial reward for referral (pre April 2019) was rarely reported (5%); indeed the implementation of financial reward via national QoF incentives (post April 2019) was considered unlikely to greatly improve referral behaviours, with less than a third (32.6%) stating they would refer more. However, there was general agreement that this incentive would increase practice awareness of PR (70.1%).

Phase 2. Questionnaire: Open questions.

A third of PHCPs (33.8%) responded to the open question at the end of the survey including 5/11 PHCPs who reported referral, but did not specify frequency, (answer length 3-167 words, mean 35). Non-frequent referrers reported more open comments (43/113 38.1%) than frequent referrers (33/109 30.3%)

This gave an additional 94 comments that related directly to PR referral. These were content mapped to all 12 relevant TDF domains. The comments predominately cited referral barriers.

Belief about capabilities had the highest number of comments 36/94 (38.3%) with many encompassing concerns about PR accessibility, particularly transport challenges for patients. For example, '*Location of PR too far for patients to travel and too much commitment. Patients tend to be older adults on generally low incomes. A number of my patients would attend if it was close by with no expense'.* A small number of PHCPs (3.2%) considered a patient's inability to complete pre-

PR spirometry as a referral barrier, and 10.6% of comments related to referral processes, which were reported to be lengthy and as such *'easier simpler'* processes were requested.

Connected results

In order to identify the key factors that inhibit and/or enable PHCP referral to PR, Phase 1 and phase 2 results were merged to allow for data contrast and meta-inference (16) (Table 5).

Most PHCPs believed in PR and encouraging patients to attend. Referral is most likely to be considered at annual review (indeed referral is rarely offered to patients outside of this consultation). On-screen prompts are helpful reminders, but in practice material promoting PR is rare. PHCP PR knowledge is largely gained from networking with other respiratory interested health professionals and/or CPD education. PHCPs report patients have little motivation for PR, rarely ask for referral to PR and view that patients in work are unlikely to be able to attend.

Some findings of the qualitative study were not clearly replicated in the survey results. For example, phase one qualitative data highlighted that some GPs and ANPs felt the practice nurse was best placed to undertake PR referral at the time of annual review, yet respiratory interested GPs and those undertaking annual review did not share this view. The phase two survey data supported the latter position, where 29/129 (22.5%) of practice nurses reported never referring. Therefore responsibility of PR referral is not based on profession, but is undertaken by PHCPs who are respiratory interested and/or conducting the patient's annual review.

Qualitative generalisable findings were limited in a number of areas meaning clear conclusion cannot be drawn, these included; time available to undertake referral, ease of referral process, perceptions of quality of PR programme, referral of patients when COPD symptom burden is increasing and non-referral in order to protect patient relationship.

Where generalisability is clear, a summary of the key behavioural barriers and enablers by TDF domain are shown in Table 5, demonstrating a greater number of barriers than enablers to referral. However, it is also important to report that barriers and enablers most commonly co-exist within the same domains.

Table 5 Matrix of Integrated results

✓ Enabler and agreement with Phase 1 data.

✗ Barrier and agreement with Phase 1 data.

TDF Domain	Phase 1 Qualitative study Main Factors	Phase 2 Survey Main Factors	Barrier - ✗ / Enabler - ✓
Social and Professional Role	It is largely seen as the practice nurse role, or staff undertaking COPD review. The best time to refer a patient is when they are stable Most PHCPs believe in encouraging patients to attend.	Not clearly PNs role, but PHCP doing annual review is most likely referrer. Disagree Agree	PHCP undertaking annual review (not necessarily the PN)- ✓ Not generalizable in quantitative data. ✓
Knowledge	Generally a good basic knowledge Little detailed local programme knowledge Knowledge is largely gained from CPD/networking	Agree (Generally higher in frequent referrers) Disagree (Higher local knowledge in frequent referrers) Agree	Enabler – but room for improvement ✓ ✓
Environment	There is a lack of time in practice. Referral is only considered during non-acute COPD focused consultations. There is a lack of PR promotional material available in practices.	Disagree Agreed (some infrequent referrers reported not to see COPD patients) Agree	Not generalizable in the quantitative data. ✗ ✗
Memory	On screen reminders are important Referral prompted when patients have symptoms that are worsening	Agree Disagree	✓ Not generalizable in the quantitative data.
Optimism	Patients do not want PR/are not motivated PR providers do not offer a good service.	Agree Some agreement more so with infrequent referrers	✗ ✗
Belief about consequences	PR is good for patient's physical and psychological health. PR may harm patients (psychologically) Pushing PR might harm my relationship. Patients will not always attend and complete post referral.	Agree Disagree Disagree General agreement.	✓ Not generalizable in the quantitative data. Not generalizable in the quantitative data. ✗

Belief about capability	Talking to patients about PR is challenging. Patients in work are unable to attend PR Transport is a barrier Not for patients with oxygen Not for patients who smoke Best suited to those who have frequent exacerbations	Some agreement more so with infrequent referrers. Agree Agree (Open question) Disagree Disagree Disagree	✗ ✗ ✗ Not generalizable in the quantitative data. Not generalizable in the quantitative data. Not generalizable in the quantitative data
Social influences	Lack of PR provider engagement and feedback to referrer Patients do not ask for PR	Agree Agree	✗ ✗
Skills	Referral to PR by PHCP is low Referral process is relatively easy	Agree Disagreement, particularly by infrequent referrers.	✗ Likely barrier
Reinforcement	Financial reward increases referral rates Patients decline PR Financial reward increases practice awareness	Most don't think this would change behaviour. Not captured explicitly Agree	Not generalizable in the quantitative data Likely barrier ✓
Goals	No set in-practice process to improve or review referral rates.	Agree	✗
Intentions	Referral acceptance takes time General desire to refer more patients.	Not captured explicitly Not captured explicitly	Likely barrier Likely enabler
Emotion	PHCPs are fearful on behalf of patients Frustration with PR providers	Concern over access abilities (expressed in free text, may capture PHCP fear) Not captured explicitly.	✗ ✗
Behavioural Regulation	PHCPs do not know how many patients they have referred. PHCPs have no planned intentions to change behaviour	Agree Largely agree, although some emerging interventions (free text)	✗ Likely barrier

Discussion:

This is the first time the Theoretical Domains Framework has been applied to a mixed-methods study to understand the key factors that determine referral to PR by PHCPs.

Results highlighted multiple intertwined barriers and few enablers across all TDF domains Many (although not all) of the findings from the qualitative study were affirmed by the more generalisable survey and highlight that referral to PR from primary care remains poor, and that PHCPs believed that PR was beneficial for patients and wanted to refer more. They did however, request greater engagement from providers, better knowledge of local programmes and improvements in PR promotion. They also reported that in-practice goals and monitoring of referrals to address the shortfall in patients referred were rare.

However, PHCPs collectively reported low confidence in patients' abilities and motivations to attend PR, a belief likely to be strengthened by reports of few patients requesting referral. Beliefs about low uptake may explain why referral is commonly offered at times of increasing COPD symptoms, thus acting as a lever to referral acceptance. Infrequent referrers reported reduced confidence in encouraging un-motivated patients to attend, with similar findings reported in phase 1 data as PHCPs expressed concerns around the protection of relationships with patients. Venue accessibility also appears to be a barrier and whilst the direct survey question (question 21) appeared not to overtly agree with this, both phase 1 and the phase 2 open question results highlighted transport as both a practical and financial barrier.

Variability in referral rate by PHCP profession was an unexpected finding and offers insights that (1) few PNs refer and (2) where it is considered to be the 'respiratory nurse' role, referral opportunities may become reduced. The association between referral frequency and respiratory qualification is also a new finding. ANPs were those most likely to refer and to have respiratory qualifications.

Relation to other studies.

This mixed methods TDF based study finds agreement with many key referral factors presented in our previous inductive qualitative study using the same data (6) and

Cox et al's (25) TDF-applied systematic review which included patients and HCPs views on PR barriers and enablers. However this primary mixed methods study reports additional findings. It disputes that the PN is the main referrer to PR within primary care, and questions the value of practice based financial reward as a referral incentive. It also highlights that the referral process itself is not straightforward and there are no sanctions for non-referral, but that there is time in practice to refer.

Increasing the population sample and geographical reach in this study strengthens current known referral barriers including, poor patient motivation, few in-practice resources, perceived venue access difficulties and little awareness of local PR provision (26-29). Subjective patient assessments including PHCPs perceptions of patients capabilities and motivations have been described as influencing PHCP referral decisions here and previously published (6). This is a novel finding in relation to PR referral, yet similar HCP pessimistic attitudes, relating to a patient's capability and motivation to access services and change behaviours to improve health outcomes have been reported in the primary healthcare management of reducing cardiovascular disease risk in people with serious mental illness (30, 31).

Phase one and inductive data analysis (6) suggested that offering PR at COPD symptom increase was common yet this was unconfirmed in the survey results. This may demonstrate further social desirability reporting as previous analyses have demonstrated patients attending PR to have 1.24 hospitalisations per patient-year 95% CI (0.66-2.34) suggesting sicker patients are those most likely to be offered PR (32). However, referral at this time supports both PHCP and patients' concerns about patient's capabilities (6, 25, 33), meaning lower acceptance and adherence to PR is probable, and negative PHCP beliefs about referral outcomes are likely to perpetuate. An alternative approach and one that appears not to be currently undertaken is to refer at the point of an acute exacerbation of COPD, which maybe a referral lever (33).

In our original inductive analysis (6), we reported that financial incentives may be important, yet results in this current study are mixed and PHCPs appear uncertain of their value. It will be interesting to observe the impact of the newly implemented financial rewards for PR referral in England, but where similar QoF rewards were implemented for referral to diabetes programmes, uptake did not greatly improve (34). Given positive correlations between

referral rates and CPD education, efforts to increase the number and education of the primary care workforce by Health Education England (35, 36) is encouraging.

The literature also supports a general consensus that for patients in employment, PR is largely considered inaccessible (6, 28). This was reported as a barrier by the frequent referrers more than the infrequent referrers, which questions whether PR knowledge itself is a potential barrier as previously reported (6) and that PHCP beliefs influence subsequent referral behaviours.

Strengths and Limitations

Using the previously published qualitative data to inform the questionnaire offered valuable insights into PHCP referral practices and is a key strength of this research.

The range and number of PHCPs included from across the UK were broadly representative of the general practice nursing workforce, whilst less so for others, notably doctors and is a limitation (37). We recognise that predominately respiratory interested participants may have taken part in this study which may skew results, and it is noted that online participants reported higher referral practice and respiratory qualification(s) than their counterparts, which may be a study limitation, suggesting that more emphasis should be placed on the perspective of the infrequent referrers. Adopting additional recruitment strategies such as via general practice-based conferences is seen as a study strength which sought to capture a range of PHCPs views. Demographic similarities across all 3 recruitment streams highlight study design attempts to reduce participation and sample selection biases. Questionnaire specific biases relating to self-reporting response is a source of potential weakness, specifically where responses maybe perceived to be 'socially acceptable', otherwise known as social desirability (38). This may offer some explanation around the variation observed in the belief about capabilities domain of the integrated results matrix (Table 5). Grouping participants by reported referral frequency is a study strength, particularly as the aim is to understand both what supports and inhibits referral. Another limitation is that we are not sure about exact response rates where distribution was unknown.

Much of the validity of the TDF is gained from its direct application with HCPs, as utilised here. Transcript content mapping to 84 constructs is complex and time consuming as also described by others (39) but was considered the most comprehensive approach in the absence of a gold standard approach to TDF application (39). The TDF offers a functional approach to behavioural data analysis, most likely to be helpful when there is little to no underlying knowledge of the investigating phenomenon. However, the interrelations between referrer, patient and provider have previously been reported to be important factors in the referral journey (6). Yet, the TDF does not offer causal determinants of behaviour (20) and alignment to predetermined domains reduces the ability to consider any phenomena falling outside those domains and the likely connecting relations, meaning the whole picture maybe missed and is a potential limitation.

All authors had different professional backgrounds, one of whom (JW) is an experienced respiratory nurse specialist which may have altered data analysis although transparency and frequent team analysis sought to reduce potential bias.

Implications for policy and practice

Whilst this paper highlights multiple barriers in referring patients with COPD to PR, barriers to high quality healthcare for patients with COPD persist across health services, spanning the disease trajectory (40). It is interesting to note that few participants in our study thought that a financial incentive was important. It is however difficult to assess this given that face to face PR programmes were suspended across the country as a result of the COVID-19 pandemic. However, as previously highlighted QOF incentives for referral to diabetes programmes did not greatly improve uptake. What we need to do now is to design and test an intervention for improving referral to PR which incorporates multi-system level changes. Additional intervention considerations will also need to include post COVID-19 infection control adaptations, as well as managing increases in service demands arising from programme suspension backlogs and new referrals, including COVID-19 survivors (41).

Conclusions

This is the first mixed methods research study to examine the factors that inhibit and enable referral to PR for patients with COPD from a primary care perspective. Whilst knowledge and respiratory qualification appear to be enablers, many barriers persist which must be overcome to increase referral opportunities for all eligible patients. The most important aspects to address are to increase PR provider engagement with referrers, increase PR awareness and support for potential patients and all PHCPs, including those with respiratory qualifications and to increase PHCP internal motivation for PR referral, particularly for those patients in work and those with less symptom burden. Mapping these TDF findings to behaviour change techniques (BCT) are important next steps which will enable clear targeted interventions to be identified and tested in clinical practice, which will ultimately increase referral to PR, thereby improving COPD patients' health outcomes and reducing health service utilization.

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Ethics approval and consent to participate

Ethical Approvals: Phase 1 approval granted by Health Research Authority: Project ID: 213367. Phase 2 approval granted by University of Birmingham: ERN_19-0439. All participants in phase 1 and phase 2 studies gave consent.

Consent for publication

Not Applicable

Availability of data and material

The datasets during and/or analysed during the current study available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests"

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Authors' contributions

JW collected, analysed and interpreted phase 1 and phase 2 data and was a major contributor in writing the manuscript. RJ, PA, SG and AE contributed to study design, data analysis and interpretation of phase 1 and 2 data. RJ, PA and SG all contributed to the writing of the manuscript. IV supported phase 1 topic guide development, phase 1 data alignment to the TDF and the formulation of the phase 2 questionnaire where behavioural expert consensus was sought. All authors read and approved the final manuscript.

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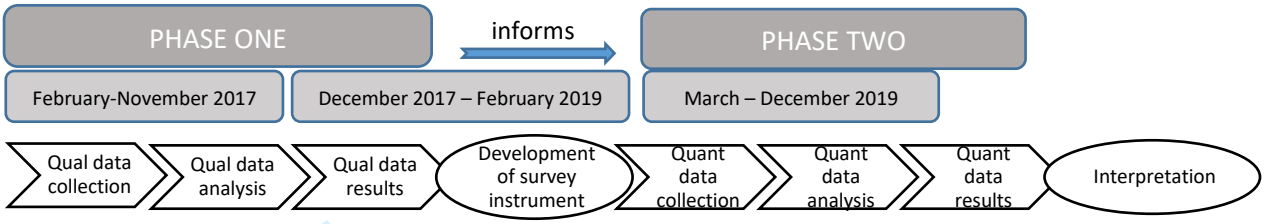
Figure 1

Figure 1: Multiphase sequential design



Additional File 1: Phase 1 interview guide

Understanding barriers and enablers for primary care health staff when referring patients with Chronic Obstructive Pulmonary Disease (COPD) to Pulmonary Rehabilitation: a qualitative study. Topic Guide for Interviews.

Interview Objectives:

- To explore the experience of primary care practitioners in relation to referral of patients with COPD to pulmonary rehabilitation.
- To gain an understanding of the main perceived barriers and enablers for referring COPD patients for pulmonary rehabilitation.
- To gain insight into whether any patient characteristics influence whether or not people with COPD are referred for pulmonary rehabilitation.

Understanding current behaviour

To start the discussion, participants will be asked to talk about their experiences of managing patients with COPD in primary care and any experience of referral for pulmonary rehabilitation

1/ Could you tell me in what context do you currently see COPD patients? (Exposure to population/target intervention within working role e.g. planned – annual review/flu jab or unplanned - exacerbation)

2/ On average how many COPD patients do you think you see per week?

3/ Do you currently refer to PR programmes?

Capability, Opportunity, Motivation – including External Context

4/ What is your understanding/view surrounding Pulmonary Rehabilitation programs in general? And in relation to your local provider?….

5/ Do you think pulmonary rehabilitation is beneficial for patients? In what ways? Or why not?

6/ How easy or difficult is it for you to refer to your local PR provider?

(Eg. Is it your role to refer? When is it appropriate to refer COPD patients to PR?)

7/ What motivates you to refer patients to PR ?

(Eg. Do patients/carers ever ask you about pulmonary rehabilitation? Does the post PR patient summary motivate you, are you reminded by prompts or other guidance?)

8/ What do you think stops you from referring patients to pulmonary rehabilitation?

Images Alternating images (between 1-4)

9/ If this person was in your COPD patient, would you consider discussing PR with them? Why? Why not?

Future

10/ Is there anything that you think could improve the primary care discussion surrounding PR and/or encourage you to make referrals to PR?

Possible prompts: Do you think a short video clip would help you motivate patients? Or computerised prompts to follow? Or a further telephone call to encourage patients? Or a firm appointment slot to discuss PR with them?

Additional file 2 TDF domain alignment using construct labelling (1)

Domain	Constructs
1.Knowledge (An awareness of the existence of something)	Knowledge (including knowledge of condition /scientific rationale) Procedural knowledge Knowledge of task environment
2. Skills (An ability or proficiency acquired through practice)	Skills Skills development Competence Ability Interpersonal skills Practice Skill assessment
3. Social/Professional Role and Identity (A coherent set of behaviours and displayed personal qualities of an individual in a social or work setting)	Professional identity Professional role Social identity Identity Professional boundaries Professional confidence Group identity Leadership Organisational commitment
4. Beliefs about Capabilities (Acceptance of the truth, reality, or validity about an ability, talent, or facility that a person can put to constructive use)	Self-confidence Perceived competence Self-efficacy Perceived behavioural control Beliefs Self-esteem Empowerment Professional confidence
5. Optimism (The confidence that things will happen for the best or that desired goals will be attained)	Optimism Pessimism Unrealistic optimism Identity
6. Beliefs about Consequences (Acceptance of the truth, reality, or validity about outcomes of a behaviour in a given situation)	Beliefs Outcome expectancies Characteristics of outcome expectancies Anticipated regret Consequents

7. Reinforcement (Increasing the probability of a response by arranging a dependent relationship, or contingency, between the response and a given stimulus)	Rewards (proximal / distal, valued / not valued, probable / improbable) Incentives Punishment Consequents Reinforcement Contingencies Sanctions
8. Intentions (A conscious decision to perform a behaviour or a resolve to act in a certain way)	Stability of intentions Stages of change model Transtheoretical model and stages of change
9. Goals (Mental representations of outcomes or end states that an individual wants to achieve)	Goals (distal / proximal) Goal priority Goal / target setting Goals (autonomous / controlled) Action planning Implementation intention
10. Memory, Attention and Decision Processes (The ability to retain information, focus selectively on aspects of the environment and choose between two or more alternatives)	Memory Attention Attention control Decision making Cognitive overload / tiredness
11. Environmental Context and Resources (Any circumstance of a person's situation or environment that discourages or encourages the development of skills and abilities, independence, social competence, and adaptive behaviour)	Environmental stressors Organisational culture /climate Resources / material resources Salient events / critical incidents Person x environment interaction Barriers and facilitators
12. Social influences (Those interpersonal processes that can cause individuals to change their thoughts, feelings, or behaviours)	Social pressure Social norms Group conformity Social comparisons Group norms Social support Power Intergroup conflict Alienation Group identity Modelling
13. Emotion	Fear Anxiety

(A complex reaction pattern, involving experiential, behavioural, and physiological elements, by which the individual attempts to deal with a personally significant matter or event)	Affect Stress Depression Positive / negative affect Burn-out
14. Behavioural Regulation (Anything aimed at managing or changing objectively observed or measured actions)	Self-monitoring Breaking habit Action planning

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Additional File 3: General Practice Staff experiences of referring patients with COPD to PR

Thank you for taking the time to complete this questionnaire, which aims to gather perspectives from staff working in primary care. This survey is designed for us to find out some of the barriers staff face when considering referring a patient with COPD to PR so please answer the questions as honestly as you can. This should only take you around 15 minutes to complete. First, please complete the following information

Geographical location of practice (please circle)	England North East North West Yorkshire and the Humber East Midlands West Midlands East of England London South East South West Scotland Wales NI
Profession (please circle)	GP/Trainer Practice Nurse ANP Other (ECP/HCP/Pharmacist)
Age (years)	18-29 30- 39 40 – 49 50- 59 60 +
Gender	Female Male
What is your ethnic group? Please circle one option that best describes your ethnic group or background	**White** English Welsh Scottish Northern Irish British Irish Gypsy, Traveller or Irish Traveller Any other White background: **Mixed/ Multiple ethnic groups** White and Black Caribbean White and Black African White and Asian Any other Mixed/ Multiple ethnic background: **Black/ African/ Caribbean/Black British** African Caribbean Any other Black/ African/ Caribbean background **Asian/ Asian British** Indian Pakistani Bangladeshi Chinese Any other Asian background: **Other ethnic group** Arab Any other ethnic group:
Do you see patients with COPD for (please circle as many as relevant)	Acute management Chronic management Both Neither
No. of years in general practice	Years: …….. Months: ……
Respiratory Qualifications	None COPD Diploma Asthma Diploma ARTP Spirometry Other
Do you currently refer patients with COPD to pulmonary Rehabilitation?	Yes - If yes - Weekly Monthly Less than monthly No - if no please explain why ……

This questionnaire is designed to ask you about your experiences with referring (or considering referring) patients with COPD to Pulmonary Rehabilitation and should take no more than **15 minutes** to complete. Please don't spend too long thinking about each question.

The questionnaire is made up of 4 elements. When rating your level of agreement with each phrase, please think about **all the things that might affect you being able to discuss pulmonary rehabilitation with your patients as well as refer.**

Please indicate your level of agreement with the following statements:

Question list	Strongly Disagree	Disagree	Neither disagree nor agree	Agree	Strongly Agree
1. I am aware of the content of Pulmonary Rehabilitation (PR) Programmes	1	2	3	4	5
2. I am aware of PR programme objectives.	1	2	3	4	5
3. I am unsure of the evidence base for PR	1	2	3	4	5
4. I know where geographically my local PR programme is delivered	1	2	3	4	5
5. I know when it is appropriate to refer a patient with COPD to PR	1	2	3	4	5
6. I can answer questions patients have about PR	1	2	3	4	5
7. I know how to contact my local PR provider	1	2	3	4	5
8. My local PR providers regularly engage with me	1	2	3	4	5
9. It is easy to refer a patient to PR	1	2	3	4	5
10. I am confident my local PR provider offers a good service for my patients.	1	2	3	4	5
11. Referral to PR is the practice nurse role	1	2	3	4	5
12. Other General Practice staff in my practice (excluding Practice Nurse) refer patients to PR	1	2	3	4	5
13. Referring patients to PR is something I have been advised to do	1	2	3	4	5
14. I am confident in my ability to encourage patients to attend PR, even when they are not motivated	1	2	3	4	5
15. I do not find it easy to discuss PR with patients.	1	2	3	4	5
16. I don't believe patients will attend PR after I have referred	1	2	3	4	5
17. Patients in work are not able to attend PR	1	2	3	4	5
18. PR is not beneficial to patients who are breathless	1	2	3	4	5
19. Patients who use home oxygen are unable to take part in PR	1	2	3	4	5
20. Patients who smoke are not motivated to take part in PR	1	2	3	4	5
21. Patients without their own transport won't be able to get to PR	1	2	3	4	5
22. Patients who live alone won't like to take part in group PR	1	2	3	4	5
23. I only refer patients if they have quit smoking	1	2	3	4	5
24. I only refer patients if they are optimised on their respiratory medication	1	2	3	4	5

Question list	Strongly Disagree	Disagree	Neither disagree nor agree	Agree	Strongly Agree
25. PR is most suited to COPD patients who have frequent exacerbations	1	2	3	4	5
26. My practice receives financial incentives for referral to PR (Before April 2019)	1	2	3	4	5
27. My practice regularly reviews COPD registers to ensure eligible COPD patients are offered PR	1	2	3	4	5
28. There are set targets within the practice to improve PR referral rates	1	2	3	4	5
29. I often forget to refer patients with COPD to PR	1	2	3	4	5
30. There is not enough time in practice to refer	1	2	3	4	5
31. I believe patients may be harmed by taking part In PR	1	2	3	4	5
32. Prompts to refer patients to PR within annual review templates are important reminders for me	1	2	3	4	5
33. The best time to discuss PR referral with patients is when they are stable.	1	2	3	4	5
34. Patients are motivated to attend PR	1	2	3	4	5
35. PR is best suited to those patients with worsening breathlessness	1	2	3	4	5
36. PR is best suited to those who have frequent exacerbations	1	2	3	4	5
37. I believe in encouraging patients to attend PR	1	2	3	4	5
38. PR reduces hospital admissions	1	2	3	4	5
39. I believe most patients will attend and complete PR following my referral	1	2	3	4	5
40. PR reduces risk of mortality	1	2	3	4	5
41. If patients attend PR this will reduce their general practice visits	1	2	3	4	5
42. PR reduces exacerbations	1	2	3	4	5
43. PR improves breathlessness	1	2	3	4	5
44. PR reduces a patient's anxiety and/or depression.	1	2	3	4	5
45. If I keep pushing patients to attend PR this will disadvantage my relationship with them.	1	2	3	4	5
46. There are good relationships in practice with PR providers	1	2	3	4	5
47. PR providers are good at communicating outcomes of referrals I have made	1	2	3	4	5
48. Resources about PR (i.e written information) are readily available	1	2	3	4	5
49. PR is something that patients ask for	1	2	3	4	5

Question list	Strongly Disagree	Disagree	Neither disagree nor agree	Agree	Strongly Agree
50. I will refer more patients to PR now there are practice QoF incentives (from April 2019)	1	2	3	4	5
51. There will be greater awareness of PR within practices because of the new QoF incentives.	1	2	3	4	5
52. More health care practitioners will discuss PR with patients because of the QoF incentive.	1	2	3	4	5
53. I believe patient attendance to PR will increase because of the QoF Incentive.	1	2	3	4	5
54. I believe the QoF incentive will not increase patients PR attendance	1	2	3	4	5

2/Please consider the interventions below. Please rate each possible intervention based on which you think would be the most helpful in improving your rates of referral to PR?

3/ Then please indicate the top 5 that you think will be the most effective in increasing PR referral within your practice. Please rank them in order 1 (highest) – 5 (lowest) in the 'Rank" column.

Question list	Strongly Disagree	Disagree	Neither disagree nor agree	Agree	Strongly Agree	Rank (1-5)
1. Health Care Professional (HCP) referring patients to PR at the time of COPD diagnosis.	1	2	3	4	5	
2. HCP prescribing PR at the time of COPD acute exacerbation.	1	2	3	4	4	
3. A standardised summary (i.e: a 2 sentences) that describes PR succinctly for HCP to recite to eligible patients.	1	2	3	4	5	
4. Face to face educational sessions for general practice staff.	1	2	3	4	5	
5. Online educational sessions for general practice staff.	1	2	3	4	5	
6. Face to face educational sessions for potential patients, carers and family.	1	2	3	4	5	
7. Online educational sessions for patients, carers & family.	1	2	3	4	5	
8. Practice staff loaning DVDs which demonstrate PR to patients.	1	2	3	4	5	
9. HCP showing patients PR recording within practice or consultation ie on a tablet device.	1	2	3	4	5	
10. Past PR patient attenders directly engage with eligible patients to highlight benefits.	1	2	3	4	5	
11. PR providers directly contacting eligible practice patients.	1	2	3	4	5	

Question list	Strongly Disagree	Disagree	Neither disagree nor agree	Agree	Strongly Agree	Rank
12. PR providers engaging with practice staff by coming into surgeries.	1	2	3	4	5	
13. Personalised letters to eligible patients from general practice advocating PR.	1	2	3	4	5	
14. Group consultations with patients, general practice staff and PR provider.	1	2	3	4	5	
15. Patients being able to refer themselves to PR.	1	2	3	4	5	
16. Patients having their own COPD health care record, similar to a COPD passport, meaning they are prompted to ask for PR.	1	2	3	4	5	
17. PR promotional material within patient pharmacy medication packs	1	2	3	4	5	
18. Greater awareness of PR in practice. i.e Posters highlighting local PR provider, benefits, etc.	1	2	3	4	5	
19. General practice staff being able to refer patients by telephone rather than manually completing referral form.	1	2	3	4	5	
20. If my practice referred more COPD patients this would increase my own referral numbers.	1	2	3	4	5	
21. Changing the name of PR to something more user friendly.	1	2	3	4	5	
22. General practice staff being taught motivational interviewing techniques would improve referral to PR.	1	2	3	4	5	
23. Lead practice PR referrer to educate and show PR video to other practice staff at practice meetings, to encourage a whole practice approach.	1	2	3	4	5	

4/ Please add any further comments/suggestions you may have……

……

……

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……

……

Many thanks for completing this questionnaire. Please return to the return box to collect your chocolate(s).

Guidelines for Conducting and Reporting Mixed Research for Counselor Researchers (1)

Research Formulation	
1.1.1. Treat each relevant article as data that generate both qualitative (e.g., qualitative findings, literature review of source article, source article author's conclusion) and quantitative (e.g., p values, effect sizes, sample size score reliability, quantitative results) information that yield a mixed research synthesis. 1.1.2. Subject each document selected as part of the literature review to summarization, analysis, evaluation, and synthesis. 1.1.3. Provide literature reviews that are comprehensive, current, and rigorous; that have been compared and contrasted adequately; and that contain primary sources that are relevant to the research problem under investigation, with clear connections being made between the sources presented and the present study. 1.1.4. Present clearly the theoretical/conceptual framework. 1.1.5. Assess the findings stemming from each individual study and the emergent synthesis for trustworthiness, credibility, dependability, legitimation, validity, plausibility, applicability, consistency, neutrality, reliability, objectivity, confirmability, and/or transferability. 1.1.6. Present the goal of the study (i.e., predict; add to the knowledge base; have a personal, social, institutional, and/or organizational impact; measure change; understand complex phenomena; test new ideas; generate new ideas; inform constituencies; and examine the past).	Pages 3/4/5
1.2.1. Specify the objective(s) of the study (i.e., exploration, description, explanation, prediction, and influence). 1.3.1. Specify the rationale of the study. 1.3.2. Specify the rationale for combining qualitative and quantitative approaches (i.e., participant enrichment, instrument fidelity, treatment integrity, and significance enhancement). 1.4.1. Specify the purpose of the study. 1.4.2. Specify the purpose for combining qualitative and quantitative approaches (e.g., identify representative sample members, conduct member check, validate individual scores on outcome measures, develop items for an instrument, identify barriers and/or facilitators within intervention condition, evaluate the fidelity of implementing the intervention and how it worked, enhance findings that are not significant, compare results from the quantitative data with the qualitative findings).	Title & pages 3 & 4 As above

1.5.1. Avoid asking research questions that lend themselves to yes/no responses. 1.5.2. Present mixed research questions (i.e., questions that embed both a quantitative research question and a qualitative research question within the same question) when possible.	
Research Planning 2.1.1. Specify the initial and final sample sizes for all quantitative and qualitative phases of the study. 2.1.2. Present all sample size considerations made for the quantitative phase(s) (i.e., a priori power) and qualitative phases (e.g., information-rich cases). 2.1.3. Present the sampling scheme for both the quantitative and qualitative phases of the study. 2.1.4. Describe the mixed sampling scheme (i.e., concurrent–identical, concurrent–parallel, concurrent–nested, concurrent–multilevel, sequential–identical, sequential–parallel, sequential–nested, and sequential–multilevel). 2.1.5. Clarify the type of generalization to be made (i.e., statistical generalization, analytic generalization, and case-to-case transfer) and link it to the selected sampling design, sampling scheme, and sample size(s). 2.2.1. Outline the mixed research design. 2.2.2. Specify the quantitative research design (i.e., historical, descriptive, correlational, causal–comparative/quasi-experimental, and experimental). 2.2.3. Specify the qualitative research design (e.g., biography, ethnographic, auto-ethnography, oral history, phenomenological, case study, grounded theory)	Pages 4-5
Research Implementation 3.1.1. Outline the mixed data collection strategy. 3.1.2. Present information about all quantitative and qualitative instruments and the process of administration. 3.2.1. Outline the mixed data collection strategy (i.e., data reduction, data display, data transformation, data correlation, data consolidation, data comparison, and data integration). 3.2.2. Provide relevant descriptive and inferential statistics for each statistical analysis.	Pages 5.6.7 Pages 24-26

3.2.3. Discuss the extent to which the assumptions (e.g., normality, independence, equality of variances) that underlie the analyses were met, as well as any observations that might have distorted the findings (e.g., missing data, outliers).	
3.2.4. Specify the statistical software used.	Page 5.7
3.2.5. Specify where the responsibility or authority for the creation of categories resided (i.e., participants, programs, investigative, literature, or interpretive), what the grounds were on which one could justify the existence of a given set of categories (i.e., external, rational, referential, empirical, technical, or participative), what was the source of the name used to identify a given category (i.e., participants, programs, investigative, literature, or interpretive), and at what point during the research process the categories were specified (i.e., a priori, a posteriori, or iterative)	
3.2.6. Specify the name of the technique used to analyze the qualitative data (e.g., content analysis method of constant comparison, discourse analysis, componential analysis, keywords in context, analytic induction, word count, domain analysis, taxonomic analysis).	
3.2.7. Specify the qualitative software used.	
3.3.1. Discuss the threats to internal validity, external validity, and measurement validity and outline the steps taken to address each of these threats to internal validity, external validity, and measurement validity.	Page 5-7, 28-29
3.3.2. Discuss the threats to trustworthiness, credibility, dependability, authenticity, verification, plausibility, applicability, confirmability, and/or transferability of data and outline all verification procedures used.	
3.3.3. Discuss mixed research legitimation types (i.e., sample integration legitimation, insider–outsider legitimation, weakness minimization legitimation, sequential legitimation, conversion legitimation, paradigmatic mixing legitimation, commensurability legitimation, multiple validities legitimation, and political legitimation).	
	Page 18-23,
3.4.1. Interpret relevant types of significance of the quantitative findings (i.e., statistical significance, practical significance, clinical significance, and economic significance).	Not applicable.
3.4.2. Conduct post hoc power analysis for all statistically non-significant findings.	Page 10-17,
3.4.3. Interpret the significance (i.e., meaning) of qualitative findings.	
3.4.4. Discuss criteria for evaluating findings in mixed research studies (e.g., within-design consistency, conceptual consistency, interpretive agreement, interpretive distinctiveness, design suitability, design fidelity, analytic adequacy, interpretive consistency, theoretical consistency, integrative efficacy).	Page 25-26

3.5.1. Describe all steps of the mixed research process. 3.5.2. Describe the context in which the mixed research study took place. 3.5.3. Ensure that the mixed research report is accurate and complete; does not distort differences within and among individuals and groups; is free from plagiarism or misrepresentation of the ideas and conceptualizations of other scholars; and contains findings that are adequately accessible for reanalysis, further analysis, verification, or replication. 3.5.4. Present all ethical considerations that were addressed in the study (e.g., informed consent, confidentiality, incentives, funding sources, potential conflicts of interest, biases). 3.5.5. Specify study approval in accordance with an institutional review board either in the report or in the cover letter submitted to the editor. 3.5.3. Present recommendations for future research that culminate in a validation, replication, or extension of the underlying study.	 Throughout paper. Page 5-6 Throughout paper. Page 5-6 and page 33 Covering letter to the editor Page 30

1. Leech NL, Onwuegbuzi AJ. Guidelines for Conducting and Reporting Mixed Research in the Field of Counseling and Beyond. Journal of Counseling & Development. 2010;88:61-9.

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Investigating primary health care practitioners' barriers and enablers to referral of patients with COPD to Pulmonary Rehabilitation: a mixed methods study using the Theoretical Domains Framework.

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Title

Investigating primary health care practitioners' barriers and enablers to referral of patients with COPD to Pulmonary Rehabilitation: a mixed methods study using the Theoretical Domains Framework.

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Key words

Chronic Obstructive Pulmonary Disease (COPD), Pulmonary Rehabilitation (PR), Primary Care, Theoretical Domains Framework (TDF). Mixed methods research.

List of Abbreviations

PR – Pulmonary Rehabilitation
COPD – Chronic Obstructive Pulmonary Disease
PHCP – Primary Health Care Practitioner
TDF – Theoretical Domains Framework

Word Count 4,268

Abstract

Objectives
Pulmonary Rehabilitation (PR) is a highly effective, recommended intervention for patients with Chronic Obstructive Pulmonary Disease (COPD). Using behavioural theory within mixed methods research to understand why referral remains low enables the development of targeted interventions in order to improve future PR referral.

Design
A multiphase sequential mixed methods study.

Setting
United Kingdom (UK).

Participants
252 multi-professional Primary Health Care Practitioners (PHCPs).

Measures
Phase 1: Semi-structured interviews. Phase 2: a 54-item paper and online questionnaire, based on the Theoretical Domains Framework (TDF). Content and descriptive analysis utilised. Data mixed at two points; instrument design and interpretation.

Results
19 PHCPs took part in interviews and 233 responded to the survey. Integrated results revealed that PHCPs with a post qualifying respiratory qualification (154/241; 63.9%) referred more frequently (91/154; 59.1%) than those without (28/87; 32.2%).

There were more barriers than enablers for referral in all 13 TDF domains. Key barriers included: infrequent engagement from PR provider to referrer, concern around patient's physical ability and access to PR (particularly for those in work), assumed poor patient motivation, no clear practice referrer and few referral opportunities. These mapped to domains: belief about capabilities, social influences, environment, optimism, skills and social and professional role.

Enablers to referral were observed in knowledge, social influences memory and environment domains. Many PHCPs believed in the physical and psychological value of PR. Helpful enablers were out-of-practice support from respiratory interested colleagues, dedicated referral time (annual review) and on-screen referral prompts.

Conclusions
Referral to PR is complex. Barriers outweighed enablers. Aligning these findings to behaviour change techniques will identify interventions to overcome barriers and strengthen enablers, thereby increasing referral of COPD patients to PR.

Strengths and limitations of this study

1: This is the first mixed methods study to use the Theoretical Domains Framework to identify barriers and enablers to pulmonary rehabilitation referral from a primary health care practitioner perspective.

2: The utilisation and combination of two differing research paradigms in this exploratory sequential approach offers novel and detailed insights through combined research lenses which encompass multiple perspectives.

3: Many geographical regions across the United Kingdom are represented and include a diverse range of primary healthcare practitioners.

4: A combination of participant recruitment approaches have been used to reduce potential sample and selection biases.

5: Generalisability of the overall findings are limited by the inability to calculate distribution and therefore response rates.

Background

Pulmonary Rehabilitation (PR) is a low cost, high value, internationally recommended intervention for Chronic Obstructive Pulmonary Disease (COPD) patients which is effective in improving exercise capacity, reducing the impact of symptoms and improving prognosis (1, 2) . It is a structured multidisciplinary intervention combining individualised exercise with disease-related education (3). Despite the clear evidence of its effectiveness, the proportion of COPD patients receiving PR is persistently low worldwide (4, 5). Our previously published inductive qualitative paper presented the experiences of primary health care practitioners (PHCPs) as key potential referrers to PR (6). We found that there was a generalised awareness of PR, but little detailed knowledge of either the programme or the clinical benefits. Relationships with PR providers were limited, but considered important. Patient characteristics, rather than clinical need, influenced referral offers and referrers frequently believed patients to be poorly motivated. PR was most commonly offered during times of disease stability (usually at COPD annual review) and ease of the referral process and financial incentives positively influenced referral. In summary, referrers reported many barriers but few enablers, which collectively resulted in infrequent discussions about PR and associated referrals.

However, in order to aid the development of appropriate interventions to improve referral rates it is important to establish the generalisability and relative importance of these findings within a broader population of PHCPs. Furthermore, applying theory to identify the psychological and structural drivers that influence behaviour (7, 8) may offer new insights to shape interventions (9).

The Theoretical Domains Framework (TDF) is a well-recognised approach which was derived from a synthesis of behaviour change theories (10), and examines the processes that influence behaviour (11). When applied, it offers explanations for behaviours, highlighting reasons that may inhibit or promote (12, 13) implementation of practice-based change (12).

Using mixed methods, and applying the TDF we sought to assess and explain the reasons for low PR referral by primary health care professionals (PHCPs) for patients with COPD. The aim of our multiphase design was to inform the development of theory informed interventions to improve PR referral rates from primary care in future.

Methods

We used a multiphase sequential design defined by two separate phases (figure 1). The cognitive and practical experiences of PHCP when considering and undertaking referral for patients with COPD were initially explored using a deductive approach by applying the TDF to data from our previously collected qualitative interviews. These findings informed a second quantitative phase, where we tested themes for generalisability using a nationwide survey of PHCP, to highlight the most relevant factors influencing referral. (14-16).

Figure 1 Multiphase sequential research design

Both data sets retained independent value and meaning, but were connected at two time points: 1) where the qualitative data was used to construct the questionnaire and 2) where phase 1 and 2 results were integrated to inform interpretation. The multiphase sequential mixed methods design therefore achieves both methodological and content integration (15, 16).

Patient and Public Involvement

There has been no public and/or patient involvement in this study.

Phase 1 Application of TDF to qualitative interview data.

We re-analysed data from our previously published inductive qualitative study (6) in which 19 PHCPs from two differing geographical regions across Central and East of England were recruited and interviewed to thematic saturation using a pre-designed topic guide. A deductive approach using content analysis (17) was used for re-analysis of the data in order to align the results to the TDF and to offer new insights.

The interview topic guide (Additional file 1) was mapped to the Capability Opportunity Motivation-Behaviour model (COM-B), a model that highlights three critical prerequisites for behaviour change (18). This model was adopted rather than the TDF to guide interviews primarily because of the practical need to reduce interview length without compromising its aim. COM-B is very closely aligned to the TDF and has been utilised as a topic guide and mapped to the TDF in a similar health care professional study (19).

Analysis

All interview transcripts were managed using NVivo v12. Barriers and enablers emerging from the interviews via content analysis were mapped to the relevant TDF domain, initially using construct labelling (10, 20) (Additional File 2). Utterances were coded once to the key TDF construct which then determined TDF domain alignment. JW undertook the initial coding then 5 transcripts were randomly allocated and distributed throughout the team (RJ, PA, and SG) and independent TDF coding occurred, followed by frequent collaborative team discussion to ensure agreement with the coding. Queries were discussed with a behavioural expert (IV).

Phase 2 Quantitative Methodology

Study Design – Cross sectional survey.

PHCPs were recruited via two main methods. Initially an invitation was included in a fortnightly newsletter emailed to members of the Primary Care Respiratory Society (PCRS). The survey was additionally distributed and shared by PCRS via their organisational Twitter and Facebook accounts. Social media distribution of the survey was further increased by individual and other organisational sharing, including the Facebook accounts of Advanced Practice UK and General Practice Nurse UK. A link for questionnaire completion was provided to the platform 'Online Survey' (21). This was open between April and December

2019. To increase participation, responders were invited to opt in to a prize draw to win an I-pad.

Simultaneously, paper versions of the questionnaire were distributed at 6 UK conferences between March and November 2019 to attending PHCPs (predominately by hand by JW, and using 'in-conference bag' distribution at one event). Upon self-completion, questionnaires were placed by participants in a locked ballot box and an optional token of appreciation was offered. Paper questionnaires were manually entered onto 'Online survey' by JW.

As this was exploratory research, no *a priori* sample size calculations were performed. A pragmatic approach to study closure was adopted, this being online availability for a period of 8 months, distribution of the questionnaire at several appropriate PHCP targeted events, and that a reasonable range of PHCP had responded.

Methodology– Instrument Design

The cross-sectional survey (Additional file 3), collected (1) individual socio-demographic data, (2) current referral experiences, using TDF-based Likert scale questions (n=54) and (3) any new or complementary issues which may not have been previously mentioned, using an optional open question (22).

Socio-demographic data

These included questions on geographical location of practice, job title, post-qualifying respiratory education and estimated frequency of PR referrals, using questions with pre-specified options.

Psychometric data

Barriers and enablers for PR referral identified from the phase 1 qualitative findings were converted into belief statements (20), including some that sought to test direct understanding. All questions were generated and aligned to the TDF by the coder (JW) and validated by other team coders (RJ), including a TDF expert (IV). 54 closed, fully labelled 5-point, Likert scale questions/belief statements were included with responses ranging from 'strongly disagree' to 'strongly agree' and a mid-point rating. Some statements were reversed as an

opposite belief to that frequently reported in the phase 1 data. These design elements were purposely selected to improve reliability and validity (23).

The final survey mapped the 54 belief statements and open question section to 12 out of 14 theoretical domains ('emotion' and 'behavioural regulation' was excluded, given its low mapping in phase 1 results). Two rounds of survey piloting were undertaken with five practice nurses and the questionnaire refined to ensure question clarity and clearer completion instructions.

Analysis

All data were exported into an excel spreadsheet and STATAv16 used to conduct simple descriptive statistics (frequencies and percentages), dichotomising into Agree/Strongly Agree *vs* the remaining options. Free text that directly related to barriers and enablers of referral practice was content-mapped to the TDF and thematic analysis applied (24).

Results: Phase 2

Response rates.

Paper surveys (>1100) were distributed across 6 UK primary care focused events which were attended by a variety of PHCPs. 154 (~14%) were returned and 134/154 (83%) completed the survey sufficiently and were included. Online, it is unknown how many potential practitioners read the survey invitation, therefore participation rates could not be calculated. 123 participants started the online survey, but only 99 (80.5%) completed it and were included in the analysis.

Full details of the paper survey distribution and return rates can be found in additional file 1.

Description of participants

Table 1 presents the socio-demographic characteristics for participants in the phase 2 quantitative (n=233) studies. Participants characteristics for phase 1 (qualitative) are available in the previously published paper (6)

In contrast to the qualitative study where 6/19 (32%) were GPs, the survey respondents were predominantly female nurses. Nurse respondents were similarly distributed across both conference and online groups (110/134, 82.1%; and 76/99, 76.9% respectively) and responders from both sources had similar time working in practice. However, respondents recruited through conferences, compared to those who responded online, tended to be younger (28% < 40 years of age), more likely to be practice nurses rather than other types of professionals, but were less likely to have respiratory qualifications, to see COPD patients or to refer them to PR.

Table 1 Baseline demographics of phase 2 participants

		Phase 2 Survey (n=233)		
		Conference (n=134) (%) (%)	**Online (n=99) (%)**	**Total (n=233)**
Primary Health Care Practitioner Role	General Practitioner (GP)	18 (13.4)	11 (11.1)	29 (12.5)
	Advanced Nurse Practitioner (ANP)	25 (18.7)	32 (32.3)	57 (24.5)
	Practice Nurse (PN)	85 (63.4)	44 (44.5)	129 (55.4)
	Emergency Care Practitioner (ECP)	1 (0.8)	1 (1)	2(0.9)
	Pharmacist	-	4 (4)	4 (1.7)
	Health Care Assistant (HCA)	-	1 (1)	1 (0.4)
	Other	5 (3.7)	6 (6.1)	11 (4.7))
	Total responses	134/134 (100)	99/99 (100)	233/233 (100)
Sex	Female	115 (91.3)	92 (92.9)	207 (92)
	Male	11 (8.7)	7 (7.1)	18 (8)
	Total responses	126/134 (94)	99/99 (100)	225/233 (96.6)
Age (years)	18-29	5 (3.8)	2 (2)	7 (3.0)
	30-39	32 (24)	11 (11.1)	43 (18.5)
	40-49	36 (27.1)	40 (40.4)	76 (32.8)
	50-59	49 (36.8)	40 (40.4)	89 (38.4)
	60 +	11 (8.3)	6 (6.1)	17(7.3)
	Total responses	133/134 (99.3)	99/99 (100)	232/233(99.6)
Ethnicity	White British	112 (84.2)	87 (87.9)	199 (85.7)
	White other	8 (6)	4 (4.1)	12 (5.2)
	Asian/Asian British	7 (5.3)	3 (3)	10 (4.3)
	Mixed Multiple Ethnic Groups	1 (0.7)	2 (2)	3 (1.3)
	Black/African/Caribbean/Black British	2 (1.4)	-	2 (0.9)
	Other ethnic group	3 (2.4)	3 (3)	6 (2.6)
	Total responses	133/134 (99.3)	99/99 (100)	232/233(99.6)
Practice Geographical Location	Scotland	1 (0.8)	3 (3)	4 (1.7)
	England North East and West	31 (23.6)	15 (15.1)	46 (20)
	Yorkshire and the Humber	8 (6.1)	6 (6.1)	14 (6)
	Midlands (East and West)	20 (15.3)	16 (16.1)	36 (15.8)
	East of England	23 (17.5)	18 (18.2)	41 (17.8)
	Wales	31 (23.6)	-	31 (13.5)
	London	3 (2.4)	6 (6.1)	9 (3.9)
	South (East and West)	14 (10.7)	35 (35.4)	49 (21.3)
	Total responses	131/134 (97.8)	99/99 (100)	230/233(98.7)

Years in General Practice	< 5	39 (29.9)	23 (23.2)	62 (27)
	6- 10	26 (19.8)	25 (25.3)	51 (22.2)
	11-15	18 (13.7)	18 (18.2)	36 (15.7)
	16-20	22 (16.8)	14 (14.1)	36 (15.7)
	21 +	26 (19.8)	19 (19.2)	45 (19.4)
	Total responses	131/134 (97.8)	99/99 (100)	230/233(98.7)
Currently see COPD patients	Acute Management	9 (6.7)	5 (5)	14 (6)
	Chronic Management	30 (22.6)	26 (26.3)	56 (24)
	Acute and Chronic management	81 (60.9)	67 (67.6)	148 (64)
	Don't see COPD patients	13 (9.8)	1 (1)	14 (6)
	Total responses	133/134 (99.3)	99/99 (100)	232/233(99.6)
CPD Respiratory Qualifications*	None	62 (46.3)	19 (19.2)	81 (34.8)
	COPD Diploma	28 (20.9)	50 (50.5)	78 (33.5)
	Asthma Diploma	38 (28.4)	52 (50.5)	90 (38.6)
	ARTP Spiro	34 (25.4)	40 (40.4)	74 (31.8)
	Other	16 (11.9)	26 (26.3)	42 (18)
	> one qualification	32 (23.9)	51 (51.5)	83 (35.6)
	Total responses	210	238	448
Reported PR referral practice	Yes (frequency not specified)	-	11 (11.1)	11 (4.7)
	Weekly	16 (12)	32 (32.3)	48 (20.7)
	Monthly	40 (30.1)	21 (21.2)	61 (26.3)
	< Monthly	43 (32.3)	29 (29.3)	72 (31)
	None	34 (25.6)	6 (6.1)	40 (17.3)
	Total	133/134 (99.3)	99/99 (100)	232/233(99.6)

Referral to PR by type of healthcare professional

Overall, 109 (49.1%) reported being frequent referrers to PR, with GPs being less likely to refer and other professions including emergency care practitioners and nurse practitioners and ANPs more likely to refer. Referral was also higher among those with one or more continuous practice development (CPD) respiratory qualifications. However, this may be partly related to such qualification being higher among ANPs (82.5% (47/57)) and other grouped professions (58.8% (10/17)) than among GPs (17.9% (5/28)). More than 10 years spent in general practice appeared to marginally increase referral frequency (60.7%; 51.8%).

Table 2 PHCP referral practice*

	Frequent Referral n (%) (weekly or monthly) Total n=109	**Infrequent referral n (%) (>monthly or no referral) Total n=113**
Staff type		
GP (n=28)	10 (35.7)	18 (64.3)
PN (n=120)	57 (47.5)	63 (52.5)
ANP (n=57)	32 (56.1)	25 (43.9)
Other (ECP/NP/Pharm/HCA) (n=17)	10 (58.8)	7 (41.2)
CPD Respiratory Qualification	84 (77.1)	59 (52.2)
Years in Practice > 10 years**	65/107 (60.7)	58/112 (51.8)

*11/99 online PHCPs specified that they referred to PR but did not specify referral frequency and were removed from this analysis.

** 107/109 and 112/113 reported time spent in general practice

40/233 (17.2%) responding PHCPs reported never referring to PR, with the largest group being practice nurses (29/40; 72.5%). 33 of 40 PHCPs offered a variety of reasons for non-referral including; not considering it to be part of their role, not seeing COPD patients or not knowing they could refer (12/33; 36.4%). Others reported it was undertaken by other respiratory specialist/interested health care professionals across primary and secondary care settings (12/33; 36.4%). Further reported reasons were unsure how to and/or a lack of training (5/33; 15.1%), uncertainty about local service provision (3/33; 9.1%) and 1/33 (3.0%) reported belief that patients were not interested.

Phase 1 Results: TDF analysis of the qualitative interviews

Table 3 shows the referral behaviour of PHCPs mapped to all 14 TDF domains. The most frequently mapped domain was social and professional role (n=287 times) whilst the least mapped was behavioural regulation (n=4).

303 Table 3: Phase 1 Mapping of barriers and enablers for referral to TDF domains

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TDF Domain (construct mapping frequency)	Content mapping (n)	Key points	Evidence supporting
1.Social and Professional Role (A coherent set of behaviours and displayed personal qualities of an individual in a social or work setting)	(n=289)	Referral was considered everyone's role, however it was considered best undertaken by the PHCP during disease stability and at annual review. It was often considered to be the practice nurses' role, but also respiratory-interested others. Most PHCPs considered it their duty of care to motivate patients. Only 1 of 19 PHCPs described implementing practice leadership to improve PR awareness and/or referral.	*It is largely the nurses' job to see stable COPD patients at an annual review and that is the most appropriate time to refer to pulmonary rehabilitation, not during an acute exacerbation' –GP5* *No, I think it's everybody's role, I mean I'm not sure about my non-respiratory colleagues.* PN2 *So we've put forward a proper business case for it. (Local PR service).* GP4
2.Knowledge (An awareness of the existence of something)	(n=256)	17 of 19 PHCPs knew of the existence of PR and a generalised understanding of its purpose. PR Knowledge was reported to be gained through post qualification education and networking events. Local PR knowledge such as programme timing, waiting list (if any), and availability of patient transport, was often unknown and were described as inhibitors to referral discussions. The referral criteria Medical Research Council (MRC) dyspnoea Score ≥3 was frequently cited as a referral prompt, although some PHCPs wanted to refer patients with MRC scores of 2 and felt unable to.	*I think it's a fundamental treatment and I think it's better than drugs.* PN7 *Do you currently refer to PR? P -I wouldn't know where.* GP2 *I don't know how to describe pulmonary rehab to a patient.* GP3 *I just feel that we don't know enough about the program to confidently hand on your heart sell it.* PN1 *'We've also got the barrier of we can only refer if their MRC is 3 or 4 or 5'* PN5
3. Environment (Any circumstance of a person's situation or environment that discourages or encourages the development of skills and abilities,	(n=195)	PR referral was often considered inappropriate in non-COPD focused consultations or when a patient was consulting for an acute exacerbation. Clinical time constraints were often described as inhibiting referral, although annual review considered appropriate time	*I think in our role when you're treating potentially acutely unwell people in a really limited time span then it's, it is realistically going to be hard to cover everything, really hard.* ANP2

independence, social competence, and adaptive behaviour)		because of its clinical focus, template design and longer consultation time. PHCPs often stated little PR promotional material was available in practice for patients or staff; there were however mixed views on the potential value of this. 3 practices had initiated an in-practice 12 weekly, 1 hour generic exercise group, this appeared to be seen as equivalent to PR by 1 PN.	*On the annual review well I follow the template and when I get to the pulmonary rehab I mention it then and I say, 'Would you like to go?'* PN3 *It would be useful for our local organisation I think to give us some little leaflets about what they do so we can give that to patients about the local service* ANP4 *I'm not against a leaflet but have you seen how many posters and leaflets we have on our walls?* GP2
4.Belief about capabilities (Acceptance of the truth, reality, or validity about an ability, talent, or facility that a person can put to constructive use)	(n=141)	Individual PHCP PR referral confidence varied, with particular uncertainty expressed in how to best 'sell PR' and how to motivate un-motivated patients. Although most were confident in reassuring patients that PR would improve breathlessness. PHCPs with positive non-pharmacological and exercise beliefs appeared to have greater confidence in PR benefit and patients' abilities A number of PHCPs described COPD patients as uninterested in improving their health and some PHCPs emphasised patients needed to be committed to PR. Whilst some PHCPs described 'knowing' which patients would accept referral, others described undertaking subjective patient assessment and expressed concerns about patients' exercise capability in the presence of breathlessness. For patients receiving oxygen therapy there was much uncertainty of the benefit of PR and an assumption that Oxygen/secondary care teams would have previously offered this. Most PHCPs considered key environmental factors such as session timing, venue accessibility, patient financial hardship, as barriers for most patients. Patients in work, or	*I would need to feel confident, before I speak to this patient about it.* ANP4 *I quite like... Non-medicinal treatment…think if you're excited by it then it's easier for patients to get excited by it as well.* GP4 *They are also very very clear that there not going to take anyone on their course unless there is 100% commitment at the beginning that they are going to complete the course.* ANP1 *You look at the ones that you think would more likely go.* ANP4 *It's really basically where I see a need, where I see they can benefit – ANP1* *If the patients already on oxygen therapy, then it's likely that they've already been seen by them.* HCA *The main stumbling block is that you come across is " I'm not going every week for x number of weeks, I can't afford it, I haven't got that much time, how do you expect me to get there ….not a huge number of our patients drive.* GP4

		those able to take the dog for a walk/wearing walking boots were considered 'too well' for PR.	*There's some patients that I would like to refer but they can't go because of work commitments.* PN3 *'It's quite surprising that some patients are still working at odd jobs and things like that and keep them very active. So, for those patients it's not so important.'* PN3
5.Memory (Inc: Decision making) (The ability to retain information, focus selectively on aspects of the environment and choose between two or more alternatives)	(n= 118)	Some PHCPs reported forgetting to refer patients to PR, however, embedded system reminders often found in COPD review templates or on-screen prompts were cited as important for most PHCPs. Patient behaviour and clinical presentation altered decision making processes for some PHCPs for example not referring current smokers, or remembering PR in light of increasing COPD symptom burden and disease deterioration, whilst earlier concerns for patient capability and commitment became less apparent.	*I do need a reminders because my head's full, so as I say, I don't want to tick boxes but I do need a prompt.'* PN7 *That's something that we do, so we have a prompt that pops up saying has this patient been referred to pulmonary rehab.* GP5 *I think I go through phases, I'll do it really well for a while and somebody has motivated me and then I'll forget that and do something else.* PN7 *Breathlessness and exacerbations, I think, would be the key factors.* GP3
6.Optimism (The confidence that things will happen for the best or that desired goals will be attained)	(n=110)	PHCPs frequently reported that patients did not want to attend PR, citing disease stigma and lack of activation as underlying reasons. Negative patient responses appeared to dampen PHCPs optimism and reduce subsequent referral offers. Positive patient experience however had the opposite effect. Positive and negative perceptions of PR providers were also reported on the basis of service quality and frequency of referral acceptance, this appeared to influence referral behaviour.	*The first thing you think, 'Are they going to do it?* ANP4 *Patients don't want it.* PN5 *Even if you then said what the evidence was and how you could improve, it's – I think that group of people are really difficult to engage* .GP3 *If they're negative anyway everything you suggest they sort of have an answer, 'Oh no that won't work.* PN4 *The longer the wait time, the less likely they are to turn up. HCA* *I don't think it's the greatest service, it does have an impact because I'm not going to tell my patients to go.* PN7

7.Belief about consequences (Acceptance of the truth, reality, or validity about outcomes of a behaviour in a given situation)	(n=107)	There was a general sense that PR is positive with many health and psychological benefits, but beliefs captured in other domains impacted on PHCP belief about consequences of referral offer. A small number of PHCPs expressed concern that PR might worsen patient's depression and/or anxiety, particularly for those socially isolated.	*I've seen patients that have been… their lives have been transformed in the first year.* PN7 *Might have prevented the exacerbation if they'd gone* PN5 *I will say that when I'm talking to patients, say it's better than drugs, but I still get a closed reaction.* PN7 *If we can improve patient's breathing they're less likely to get anxious, that makes them less likely to dial 999 or likely to do something about it. And perhaps use their rescue packs more appropriately.* ANP4 *I wouldn't want to mention it if it ended up being that I'm saying there's this really good helpful programme but actually if she's so effected by her disease that she doesn't leave the house then I wouldn't want to have mentioned it and then not for her not to be able to go.* ANP2
8.Social Influences (Those interpersonal processes that can cause individuals to change their thoughts, feelings, or behaviours)	(n=84)	Out of practice engagement from PR providers and PR advocates were important in increasing overall awareness and positively influencing referral behaviour. Almost all PHCPs described little to no engagement from providers themselves, and described not knowing what had happened to completed referrals. PHCPs also reported that positive patient PR experiences positively influenced PHCPs referral behaviour and that family can be influential, yet patients rarely ask for PR. PHCPs described a need to increase PR's profile publicly and for it to be marketed similarly to pharmacological treatments. The name PR itself was considered by some PHCPs to be a negative influence as 'rehab' was deemed to have undesirable connotations.	*Our referral rate has gone up a lot since the respiratory MDT's because every single one of those patients has subsequently had a referral*. GP4 *At the moment I wouldn't know how many people we refer, is that referral going up, Nobodies giving us feedback from the rehab team about how we are doing as a surgery.* PN1 *If patients that have been to it you know express a positive experience that is something you can share with other people that you are trying to refer.* GP1 *I asked him to talk to his wife, because I knew she'd want him to go, because I know her through a different channel, and erm... he's come back and said 'Ooo I'll give it a shot.* PN5

			Nobody has picked up a leaflet and walked in with it and said can you refer me, nobody has. ANP1
9.Skills (An ability or proficiency acquired through practice)	(n=79)	The physical act of referring patients to PR were described as largely straightforward by most PHCPs, although there was no standardised process across the 2 regions. Most undertook this action independently, although there were descriptions of practice administrators helping. However, frequency of referral to PR when described in interviews, was far lower than that which was documented on the returned research interest form.	*Do you currently refer people to pulmonary rehab? Some, some.* PN7 *I've been at this practice for nearly three years now and it's sort of something that falls really far down on your list of things that you do on your COPD review, so it's always the last thing that you come to.* GP4 *It's very easy. It's a form erm it's a just a single sheet.* PN2 *Quicker, easier referral, much easier referral method* PN7
10.Reinforcement (Increasing the probability of a response by arranging a dependent relationship, or contingency, between the response and a given stimulus)	(n=59)	There appeared to be no direct sanctions for non-referral of patients, although practice financial rewards in one region appeared to enhance awareness and referral. Outside of these practices there was a suggestion that financial incentives would be advantageous, additionally calculating health cost benefit for PR attendance was suggested as potential enabler. Additionally reinforcements such as those offered by social influences and patients were also described to be valuable.	*We've got this thing called A** that we're doing for, you know it was the QOF before, so like A** has taken over that so I think because of the A** the doctor who is the lead A** leader he discusses that a lot because of course you get points, you still get the points for it like QOF. So the more we refer is the more points we get so there's an incentive there for the practice.* PN6 *Yeah if they did something on the BBC or something they might all be in the next day saying, 'Oh I wanna do that'.* PN4 *If you spent 5 minutes with somebody then at the end of that they agreed to go and then they attended, then you would be motivated to do it again.* GP5
11.Goals (Mental representations of outcomes or 'end states' that an individual wants to achieve)	(n=47)	Referral to PR was a low-level goal for most PHCPs, but one that varied by consultation type and was not considered during an acute exacerbation review. However, referral appeared to become a goal in the presence of worsening patient symptoms.	*As a practice, when we do the acute exacerbation we're pretty much focus on the acute exacerbation.* GP4 *I refer a few to pulmonary rehab but I don't do as many as I feel I should.* PN7

		Some PHCPs described wanting to refer more patients and learning strategies to improve patient acceptance, but described frequent discord between PHCP and patient goals which PHCPs found challenging. No PHCPs discussed set practice PR referral targets although one GP reported plans to set up a programme geographically closer to practice (captured as leadership in the domain social & professional.)	*She was more receptive because she'd had a few flares up, not after the first one but because she's had a few. And I think that makes them more receptive to doing that sort of thing*. ANP4 *One hand I'm wanting them to engage with the disease process so that actually they've got more skills to self-manage and that's going to actually keep them much better for the rest if their whole of their life, on the other hand they don't want to be classified as ill.* ANP1 *It would help me in trying to find out why she didn't go because I would challenge her on it and try and get her to go again and give it another go and that would help me in.* ANP4
12.Intentions (A conscious decision to perform a behaviour or a resolve to act in a certain way)	(n=39)	Some PHCPs have described adopting patient-aimed strategies that included persistence and warnings against overreliance and/or possible reduced effectiveness of pharmacological treatments in an effort to move patients to a state ready for PR referral. There also appeared to be an understanding that acceptance for many patients takes time.	*I said you know you've used those rescue packs a lot you know if we could get your breathing a bit better, perhaps you wouldn't be so bad….., and she said, alright then I'll see, do the referral.* ANP4 *How would you feel about something that's not medicine based but will probably help you as much as the inhalers that we've put you on, she was suddenly very interested in.* GP4 *I look for that chink of interest and then I'll try and worm my way in then.* PN7 *He was very adamant that he didn't want to go, then I gave him the booklet*. PN5
13.Emotion (A complex reaction pattern, involving experiential, behavioural, and physiological elements, by which the individual attempts to deal with a personally significant matter or event)	(n=6)	PHCPs emotion was rarely discussed although some said they felt annoyed with providers if a referral had been rejected. There were high levels of empathy towards patients particularly amongst nurses; a small number described not	*Most of our patients are reasonably trusting and say well you seem quite excited by it so shall we give it a try.* GP4 *They're gonna meet all these people they don't know and be told to lift this walk here, do that and they're frightened, its... I'd be terrified.* PN5

		wanting to offer the hope of PR to patients and for PR providers to reject referral, this appeared to be a particular concern for patients with high disease burden.	*I just don't want to raise – if you raise patients' hopes and say – and offer it, then it can make them – you know, if they're already depressed because of the COPD, it could just make the depression worse you know, so I don't want to impact on their mental wellbeing. ANP1*
14.Behavioural regulation (Anything aimed at managing or changing objectively observed or measured actions)	(n=4)	Some PHCPs saw events such as hospital admissions/out-patient appointments as good opportunities for patients to change behaviours but for staff in those settings to instigate referral. PHCP personal behavioural regulation was low, many did not know how any they had referred or what, post referral, the patient's journey had become. One participant described the research interview as helpful in allowing them to consider how to change their referral approach, but most PHCPs did not vocalise intentions to change or modify current or future PR referral behaviours.	*I don't know how much is done in secondary care, but very often when stuff, when you've been in anywhere near secondary care people really its often quite a sit up moment, gosh this is serious enough for me to have to go to hospital, even if it an outpatient appointment.* ANP1 *This is one of your treatment choices' and perhaps I need to change, thinking about it, my approach in – er, how I word it.* ANP4 *It's trying to make it a priority.* ANP4

Phase 2. Questionnaire results: Referral practice beliefs.

Table 4 presents the number and proportion of PHCPs that agreed or strongly agreed with each belief statement by frequency of referral.

315 Table 4 Results of TDF belief statements by referral frequency

TDF Domain	TDF Questions (n=54)	Frequent referral n=109 (%) (weekly/monthly)	Infrequent referral n=113(%) (>monthly or no referral)	Total n=222(%)
1.Knowledge	I am aware of the content of Pulmonary Rehabilitation (PR) Programmes *	97/109 (89.0)	72/113(63.7)	169/222 (76.1)
	I am aware of PR programme objectives. *	99/109 (90.8)	75/113 (66.4)	174/222 (78.4)
	I am unsure of the evidence base for PR	18/109(16.5)	30/113 (26.5)	49/222(21.6)
	I know where geographically my local PR programme is delivered*	92/109 (84.4)	70/113(61.9)	162/222 (73.0)
	I know when it is appropriate to refer a patient with COPD to PR *	106/109 (97.3)	74/113 (65.5)	180/222 (81.1)
	I can answer questions patients have about PR*	88/109 (80.7)	60/113 (53.1)	148/222 (66.7)
	I know how to contact my local PR provider *	91/109(83.2)	68/113 (60.2)	159/222 (71.6)
2.Skill	It is easy to refer a patient to PR*	87/109 (80.0)	48/113 (42.5)	135/222 (60.8)
3.Social & Professional Role	Referral to PR is the practice nurse role	63/109 (57.8)	45/113 (39.8)	108/222(48.6)
	Other General Practice staff in my practice (excluding Practice Nurse) refer patients to PR	52/109(47.7)	63/113(55.8)	115/222 (51.8)
	I believe in encouraging patients to attend PR	109/109 (100)	104/112 (92.9)	213/221 (96.4)
4.Environment	Resources about PR i.e written information) are readily available	39/109 (35.7)	25/112 (22.3)	64/221 (29.0)
	There is not enough time in practice to refer	12/109 (11.0)	22/113 (19.5)	34/222(15.3)
5.Social Influences	My local PR providers regularly engage with me	31/109 (28.4)	17/113 (15.0)	48/222 (22.6)

	PR is something that patients ask for	3/109 (2.8)	8/112 (7.1)	11/221 (5.0)
	There are good relationships in practice with PR providers	44/109 (40.4)	28/112 (25.0)	72/221 (32.6)
	PR providers are good at communicating outcomes of referrals I have made	39/109 (35.8)	25/112 (22.3)	64/221 (29.0)
6.Optimism (including pessimism)	I am confident my local PR provider offers a good service for my patients.*	81/109 (74.3)	52/113 (46.0)	135/222 (60.8)
	I don't believe patients will attend PR after I have referred	16/109 (14.7)	16/113(14.2)	32/222(14.4)
	Patients who smoke are not motivated to take part in PR	7/109 (6.4)	7/113 (6.2)	14/222 (6.3)
	Patients who live alone won't like to take part in group PR	5/109 (4.6)	2/113 (1.8)	7/222 (3.2)
	Patients are motivated to attend PR	23/109 (21.6)	30/111 (27.0)	53/219 (24.2)
7.Belief about Capabilities (self)	I am confident in my ability to encourage patients to attend PR, even when they are not motivated	91/109(83.5)	73/113 (67.6)	164/222 (73.9)
	I do not find it easy to discuss PR with patients.	8/109(7.3)	25/113 (22.1)	36/222(16.2)
Belief about capabilities (patients)	Patients without their own transport won't be able to get to PR	40/109(36.7)	26/113 (23.0)	66/222 (29.7)
	Patients in work are not able to attend PR *	62/109 (56.9)	35/113 (31.0)	97/222 (43.7)
	Patients who use home oxygen are unable to take part in PR	4/109(3.7)	6/113 (5.3)	10/222 (4.5)
8.Belief about consequences	If I keep pushing patients to attend PR this will disadvantage my relationship with them.	10/109 (9.2)	10/112 (8.9)	20/221 (9.0)
	I believe patients may be harmed by taking part In PR	1/109 (0.9)	1/113 (0.9)	2/222(0.9)
	I believe most patients will attend and complete PR following my referral	55/109 (50.4)	47/112 (42.0)	102/221 (46.2)
	PR is not beneficial to patients who are breathless	3/109(2.8)	3/113(2.7)	6/222 (2.7)

	PR is best suited to those patients with worsening breathlessness	29/109 (26.6)	29/112 (25.9)	58/221 (26.2)
	PR is **best** suited to those who have frequent exacerbations	27/109 (24.8)	28/112 (25.0)	55/221 (24.9)
	PR reduces hospital admissions	101/109 (92.7)	97/112 (86.6)	198/221 (89.6)
	PR reduces risk of mortality	85/109 (78.0)	82/112 (73.2)	167/221 (75.6)
	If patients attend PR this will reduce their general practice visits	73/109 (67.0)	78/112 (69.6)	151/221 (68.3)
	PR reduces exacerbations	88/109 (80.7)	84/112 (75.0)	172/221 (77.8)
	PR improves breathlessness	103/109 (94.5)	100/112 (89.3)	203/221 (91.9)
	PR reduces a patient's anxiety and/or depression.	97/108 (89.8)	96/112 (85.7)	193/220 (87.7)
9..Goals	Referring patients to PR is something I have been advised to do*	95/107(88.8)	57/112(50.9)	152/219 (69.4)
	My practice regularly reviews COPD registers to ensure eligible COPD patients are offered PR	51/109 (46.8)	40/113 (35.4)	91/222 (41.0)
	There are set targets within the practice to improve PR referral rates	23/109 (21.1)	21/113 (18.6)	44/222 (19.8)
10. Memory (Inc.Decision Making)	I often forget to refer patients with COPD to PR	3/109 (2.8)	23/113 (20.4)	26/222 (11.7)
	Prompts to refer patients to PR within annual review templates are important reminders for me	72/109 (66.1)	69/112 (61.6)	141/221 (63.8)
	I only refer patients if they have quit smoking	1/109 (0.9)	3/113 (2.7)	4/222 (1.8)
	I only refer patients if they are optimised on their respiratory medication	17/109 (15.6)	12/113 (10.6)	29/222 (13.1)
	PR is most suited to COPD patients who have frequent exacerbations	20/109 (18.3)	20/113 (17.7)	40/221 (18.1)

	The best time to discuss PR referral with patients is when they are stable.	32/109 (29.4)	25/112 (22.3)	57/221 (25.8)
11.Reinforcement	More health care practitioners will discuss PR with patients because of the QoF incentive.	75/109 (68.8)	73/112 (65.2)	148/221 (67.0)
	My practice receives financial incentives for referral to PR (Before April 2019)	6/108 (5.6)	5/113 (4.4)	11/221 (5.0)
	I believe patient attendance to PR will increase because of the QoF Incentive.	41/109 (37.6)	58/112 (51.8)	99/221 (44.8)
	I believe the QoF incentive will not increase patients PR attendance *	29/109 (26.6)	25/112 (2.3)	54/221 (24.4)
	There will be greater awareness of PR within practices because of the new QoF incentives.	84/109 (77.1)	71/112 (63.4)	155/221 (70.1)
12.Intentions	I will refer more patients to PR now there are practice QoF incentives (from April 2019)	30/109 (27.5)	42/112 (37.5)	72/221 (32.6)

*differences in results of >20% between frequent and infrequent referrer

In general, most PHCPs had some PR knowledge (especially the frequent referrers) and understood the beneficial consequences of PR. However, resources, social influences (such as relationship with PR providers) and pessimism about patient motivations were perceived barriers by a high proportion of PHCPs, irrespective of their referral practice.

There were however, differences in domains between frequent and infrequent PR referrers.

The greatest differences were within the 'Knowledge' domain. Frequent referrers most commonly reported agreement with all 7 statements, when compared to the infrequent referrers. For example, 97.3% reported knowing when to refer to PR and 80.7% being able to answer patients' questions versus 65.5% and 53.1% of infrequent referrers.

Further group differences were demonstrated in the 'Skills' domain and 'Beliefs about (PHCP) capabilities', which showed that infrequent referrers were less confident in encouraging unmotivated patients to attend PR (67.6% versus 83.5% of frequent referrers). Reduced confidence amongst infrequent referrers was further reflected within the 'Optimism' domain and belief statement 'I am confident my local provider offers a good service' (46% against 74.3% of frequent referrers). However, over half (56.9%) of frequent referrers felt that patients in work were not able to attend PR, compared to less than a third (31%) of those who referred infrequently.

The remaining belief statements demonstrated greater group similarities than differences. Environment, Social and Professional role: Most respondents felt that there was enough time in practice to refer (84.7%) and believed in encouraging PR attendance (96.4%). Yet promotional information on PR was rarely available in practices (29%). There was no clearly identified PR referrer; less than half (48.6%) felt it was the practice nurse's role and (51.8%) reported other practice staff refer.

Social influences: Frequent referrers were slightly more likely to agree with 3 of the 4 domain belief statements than infrequent referrers. Although, collectively the groups reported both PR provider engagement and referral outcome reporting as low at only 22.6% and 29% respectively. PHCPs also reported patients rarely request referral to PR (5%).

Belief about consequences and Optimism: Most PHCPs agreed that PR offers physical health benefits, including improving breathlessness and reducing hospital admissions (91.9%, 89.6%) respectively. Yet far fewer PHCPs believed patients would attend and complete PR (46.2%), with fewer still agreeing that patients are PR motivated (24.2%).

Memory (decision-making): Only a small number of PHCPs reported forgetting to refer patients to PR (11.7%). COPD annual review templates were reported as helpful referral reminders (63.8%) and 25.8% reported the best time to discuss referral with patients was during COPD stability. Patient characteristics such as disease stability and smoking status do not appear to impede PHCP referral decisions as 98.2% reported referring smokers.

Goals, Reinforcement and Intention: in-practice review of eligible patients was not commonly reported (41%) and only (19.8%) reported in-practice targets to improve referral rates. Practice financial reward for referral (pre April 2019) was rarely reported (5%); indeed the implementation of financial reward via national QoF incentives (post April 2019) was considered unlikely to greatly improve referral behaviours, with less than a third (32.6%) stating they would refer more. However, there was general agreement that this incentive would increase practice awareness of PR (70.1%).

Phase 2. Questionnaire: Open questions.

A third of PHCPs (33.8%) responded to the open question at the end of the survey including 5/11 PHCPs who reported referral, but did not specify frequency, (answer length 3-167 words, mean 35). Non-frequent referrers reported more open comments (43/113 38.1%) than frequent referrers (33/109 30.3%)

This gave an additional 94 comments that related directly to PR referral. These were content mapped to all 12 relevant TDF domains. The comments predominately cited referral barriers.

Belief about capabilities had the highest number of comments 36/94 (38.3%) with many encompassing concerns about PR accessibility, particularly transport challenges for patients. For example, '*Location of PR too far for patients to travel and too much commitment. Patients tend to be older adults on generally low incomes. A number of my patients would attend if it was close by with no expense'.* A small number of PHCPs (3.2%) considered a patient's inability to complete pre-

PR spirometry as a referral barrier, and 10.6% of comments related to referral processes, which were reported to be lengthy and as such *'easier simpler'* processes were requested.

Connected results

In order to identify the key factors that inhibit and/or enable PHCP referral to PR, Phase 1 and phase 2 results were merged to allow for data contrast and meta-inference (16) (Table 5).

Most PHCPs believed in PR and encouraging patients to attend. Referral is most likely to be considered at annual review (indeed referral is rarely offered to patients outside of this consultation). On-screen prompts are helpful reminders, but in practice material promoting PR is rare. PHCP PR knowledge is largely gained from networking with other respiratory interested health professionals and/or CPD education. PHCPs report patients have little motivation for PR, rarely ask for referral to PR and view that patients in work are unlikely to be able to attend.

Some findings of the qualitative study were not clearly replicated in the survey results. For example, phase one qualitative data highlighted that some GPs and ANPs felt the practice nurse was best placed to undertake PR referral at the time of annual review, yet respiratory interested GPs and those undertaking annual review did not share this view. The phase two survey data supported the latter position, where 29/129 (22.5%) of practice nurses reported never referring. Therefore responsibility of PR referral is not based on profession, but is undertaken by PHCPs who are respiratory interested and/or conducting the patient's annual review.

Qualitative generalisable findings were limited in a number of areas meaning clear conclusion cannot be drawn, these included; time available to undertake referral, ease of referral process, perceptions of quality of PR programme, referral of patients when COPD symptom burden is increasing and non-referral in order to protect patient relationship.

Where generalisability is clear, a summary of the key behavioural barriers and enablers by TDF domain are shown in Table 5, demonstrating a greater number of barriers than enablers to referral. However, it is also important to report that barriers and enablers most commonly co-exist within the same domains.

Table 5 Matrix of Integrated results

✓ Enabler and agreement with Phase 1 data.
✗ Barrier and agreement with Phase 1 data.

TDF Domain	Phase 1 Qualitative study Main Factors	Phase 2 Survey Main Factors	Barrier - ✗ / Enabler - ✓
Social and Professional Role	It is largely seen as the practice nurse role, or staff undertaking COPD review. The best time to refer a patient is when they are stable Most PHCPs believe in encouraging patients to attend.	Not clearly PNs role, but PHCP doing annual review is most likely referrer. Disagree Agree	PHCP undertaking annual review (not necessarily the PN)- ✓ Not generalizable in quantitative data. ✓
Knowledge	Generally a good basic knowledge Little detailed local programme knowledge Knowledge is largely gained from CPD/networking	Agree (Generally higher in frequent referrers) Disagree (Higher local knowledge in frequent referrers) Agree	Enabler – but room for improvement ✓ ✓
Environment	There is a lack of time in practice. Referral is only considered during non-acute COPD focused consultations. There is a lack of PR promotional material available in practices.	Disagree Agreed (some infrequent referrers reported not to see COPD patients) Agree	Not generalizable in the quantitative data. ✗ ✗
Memory	On screen reminders are important Referral prompted when patients have symptoms that are worsening	Agree Disagree	✓ Not generalizable in the quantitative data.
Optimism	Patients do not want PR/are not motivated PR providers do not offer a good service.	Agree Some agreement more so with infrequent referrers	✗ ✗
Belief about consequences	PR is good for patient's physical and psychological health. PR may harm patients (psychologically) Pushing PR might harm my relationship. Patients will not always attend and complete post referral.	Agree Disagree Disagree General agreement.	✓ Not generalizable in the quantitative data. Not generalizable in the quantitative data. ✗

Belief about capability	Talking to patients about PR is challenging. Patients in work are unable to attend PR Transport is a barrier Not for patients with oxygen Not for patients who smoke Best suited to those who have frequent exacerbations	Some agreement more so with infrequent referrers. Agree Agree (Open question) Disagree Disagree Disagree	✗ ✗ ✗ Not generalizable in the quantitative data. Not generalizable in the quantitative data. Not generalizable in the quantitative data
Social influences	Lack of PR provider engagement and feedback to referrer Patients do not ask for PR	Agree Agree	✗ ✗
Skills	Referral to PR by PHCP is low Referral process is relatively easy	Agree Disagreement, particularly by infrequent referrers.	✗ Likely barrier
Reinforcement	Financial reward increases referral rates Patients decline PR Financial reward increases practice awareness	Most don't think this would change behaviour. Not captured explicitly Agree	Not generalizable in the quantitative data Likely barrier ✓
Goals	No set in-practice process to improve or review referral rates.	Agree	✗
Intentions	Referral acceptance takes time General desire to refer more patients.	Not captured explicitly Not captured explicitly	Likely barrier Likely enabler
Emotion	PHCPs are fearful on behalf of patients Frustration with PR providers	Concern over access abilities (expressed in free text, may capture PHCP fear) Not captured explicitly.	✗ ✗
Behavioural Regulation	PHCPs do not know how many patients they have referred. PHCPs have no planned intentions to change behaviour	Agree Largely agree, although some emerging interventions (free text)	✗ Likely barrier

Discussion:

This is the first time the Theoretical Domains Framework has been applied to a mixed-methods study to understand the key factors that determine referral to PR by PHCPs.

Results highlighted multiple intertwined barriers and few enablers across all TDF domains Many (although not all) of the findings from the qualitative study were affirmed by the more generalisable survey and highlight that referral to PR from primary care remains poor, and that PHCPs believed that PR was beneficial for patients and wanted to refer more. They did however, request greater engagement from providers, better knowledge of local programmes and improvements in PR promotion. They also reported that in-practice goals and monitoring of referrals to address the shortfall in patients referred were rare.

However, PHCPs collectively reported low confidence in patients' abilities and motivations to attend PR, a belief likely to be strengthened by reports of few patients requesting referral. Beliefs about low uptake may explain why referral is commonly offered at times of increasing COPD symptoms, thus acting as a lever to referral acceptance. Infrequent referrers reported reduced confidence in encouraging un-motivated patients to attend, with similar findings reported in phase 1 data as PHCPs expressed concerns around the protection of relationships with patients. Venue accessibility also appears to be a barrier and whilst the direct survey question (question 21) appeared not to overtly agree with this, both phase 1 and the phase 2 open question results highlighted transport as both a practical and financial barrier.

Variability in referral rate by PHCP profession was an unexpected finding and offers insights that (1) few PNs refer and (2) where it is considered to be the 'respiratory nurse' role, referral opportunities may become reduced. The association between referral frequency and respiratory qualification is also a new finding. ANPs were those most likely to refer and to have respiratory qualifications.

Relation to other studies.

This mixed methods TDF based study finds agreement with many key referral factors presented in our previous inductive qualitative study using the same data (6) and

Cox et al's (25) TDF-applied systematic review which included patients and HCPs views on PR barriers and enablers. However this primary mixed methods study reports additional findings. It disputes that the PN is the main referrer to PR within primary care, and questions the value of practice based financial reward as a referral incentive. It also highlights that the referral process itself is not straightforward and there are no sanctions for non-referral, but that there is time in practice to refer.

Increasing the population sample and geographical reach in this study strengthens current known referral barriers including, poor patient motivation, few in-practice resources, perceived venue access difficulties and little awareness of local PR provision (26-29). Subjective patient assessments including PHCPs perceptions of patients capabilities and motivations have been described as influencing PHCP referral decisions here and previously published (6). This is a novel finding in relation to PR referral, yet similar HCP pessimistic attitudes, relating to a patient's capability and motivation to access services and change behaviours to improve health outcomes have been reported in the primary healthcare management of reducing cardiovascular disease risk in people with serious mental illness (30, 31).

Phase one and inductive data analysis (6) suggested that offering PR at COPD symptom increase was common yet this was unconfirmed in the survey results. This may demonstrate further social desirability reporting as previous analyses have demonstrated patients attending PR to have 1.24 hospitalisations per patient-year 95% CI (0.66-2.34) suggesting sicker patients are those most likely to be offered PR (32). However, referral at this time supports both PHCP and patients' concerns about patient's capabilities (6, 25, 33), meaning lower acceptance and adherence to PR is probable, and negative PHCP beliefs about referral outcomes are likely to perpetuate. An alternative approach and one that appears not to be currently undertaken is to refer at the point of an acute exacerbation of COPD, which maybe a referral lever (33).

In our original inductive analysis (6), we reported that financial incentives may be important, yet results in this current study are mixed and PHCPs appear uncertain of their value. It will be interesting to observe the impact of the newly implemented financial rewards for PR referral in England, but where similar QoF rewards were implemented for referral to diabetes programmes, uptake did not greatly improve (34). Given positive correlations between

referral rates and CPD education, efforts to increase the number and education of the primary care workforce by Health Education England (35, 36) is encouraging.

The literature also supports a general consensus that for patients in employment, PR is largely considered inaccessible (6, 28). This was reported as a barrier by the frequent referrers more than the infrequent referrers, which questions whether PR knowledge itself is a potential barrier as previously reported (6) and that PHCP beliefs influence subsequent referral behaviours.

Strengths and Limitations

Using the previously published qualitative data to inform the questionnaire offered valuable insights into PHCP referral practices and is a key strength of this research.

The range and number of PHCPs included from across the UK were broadly representative of the general practice nursing workforce, whilst less so for others, notably doctors and is a limitation (37). We recognise that predominately respiratory interested participants may have taken part in this study which may skew results, and it is noted that online participants reported higher referral practice and respiratory qualification(s) than their counterparts, which may be a study limitation, suggesting that more emphasis should be placed on the perspective of the infrequent referrers. Adopting additional recruitment strategies such as via general practice-based conferences is seen as a study strength which sought to capture a range of PHCPs views. Demographic similarities across all 3 recruitment streams highlight study design attempts to reduce participation and sample selection biases. Questionnaire specific biases relating to self-reporting response is a source of potential weakness, specifically where responses maybe perceived to be 'socially acceptable', otherwise known as social desirability (38). This may offer some explanation around the variation observed in the belief about capabilities domain of the integrated results matrix (Table 5). Grouping participants by reported referral frequency is a study strength, particularly as the aim is to understand both what supports and inhibits referral. Another limitation is that we are not sure about exact response rates where distribution was unknown.

Much of the validity of the TDF is gained from its direct application with HCPs, as utilised here. Transcript content mapping to 84 constructs is complex and time consuming as also described by others (39) but was considered the most comprehensive approach in the absence of a gold standard approach to TDF application (39). The TDF offers a functional approach to behavioural data analysis, most likely to be helpful when there is little to no underlying knowledge of the investigating phenomenon. However, the interrelations between referrer, patient and provider have previously been reported to be important factors in the referral journey (6). Yet, the TDF does not offer causal determinants of behaviour (20) and alignment to predetermined domains reduces the ability to consider any phenomena falling outside those domains and the likely connecting relations, meaning the whole picture maybe missed and is a potential limitation.

All authors had different professional backgrounds, one of whom (JW) is an experienced respiratory nurse specialist which may have altered data analysis although transparency and frequent team analysis sought to reduce potential bias.

Implications for policy and practice

Whilst this paper highlights multiple barriers in referring patients with COPD to PR, barriers to high quality healthcare for patients with COPD span throughout the disease trajectory and persist across health service provisions worldwide (40-42). It is interesting to note that few participants in our study thought that a financial incentive was important. It is however difficult to assess this given that face to face PR programmes were suspended across the country as a result of the COVID-19 pandemic. However, as previously highlighted QOF incentives for referral to diabetes programmes did not greatly improve uptake. What we need to do now is to design and test an intervention for improving referral to PR which incorporates multi-system level changes. Additional intervention considerations will also need to include post COVID-19 infection control adaptations, as well as managing increases in service demands arising from programme suspension backlogs and new referrals, including COVID-19 survivors (43).

Conclusions

This is the first mixed methods research study to examine the factors that inhibit and enable referral to PR for patients with COPD from a primary care perspective. Whilst knowledge and respiratory qualification appear to be enablers, many barriers persist which must be overcome to increase referral opportunities for all eligible patients. The most important aspects to address are to increase PR provider engagement with referrers, increase PR awareness and support for potential patients and all PHCPs, including those with respiratory qualifications and to increase PHCP internal motivation for PR referral, particularly for those patients in work and those with less symptom burden. Mapping these TDF findings to behaviour change techniques (BCT) are important next steps which will enable clear targeted interventions to be identified and tested in clinical practice, which will ultimately increase referral to PR, thereby improving COPD patients' health outcomes and reducing health service utilization.

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Ethics approval and consent to participate

Ethical Approvals: Phase 1 approval granted by Health Research Authority: Project ID: 213367. Phase 2 approval granted by University of Birmingham: ERN_19-0439. All participants in phase 1 and phase 2 studies gave consent.

Consent for publication

Not Applicable

Availability of data and material

The datasets during and/or analysed during the current study available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests"

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Authors' contributions

JW collected, analysed and interpreted phase 1 and phase 2 data and was a major contributor in writing the manuscript. RJ, PA, SG and AE contributed to study design, data analysis and interpretation of phase 1 and 2 data. RJ, PA and SG all contributed to the writing of the manuscript. IV supported phase 1 topic guide development, phase 1 data alignment to the TDF and the formulation of the phase 2 questionnaire where behavioural expert consensus was sought. All authors read and approved the final manuscript.

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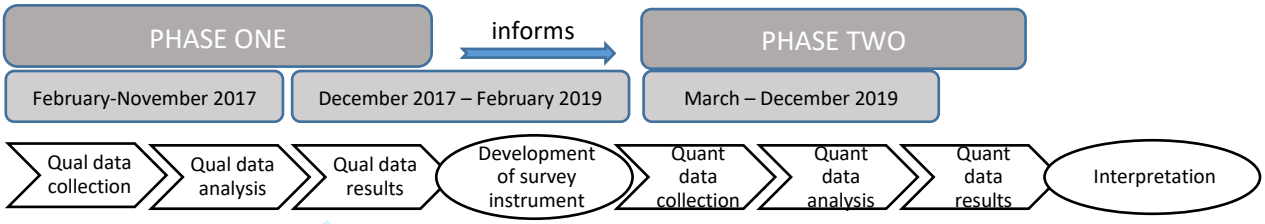
Figure 1

Figure 1: Multiphase sequential design



Additional File 1: Phase 1 interview guide

Understanding barriers and enablers for primary care health staff when referring patients with Chronic Obstructive Pulmonary Disease (COPD) to Pulmonary Rehabilitation: a qualitative study. Topic Guide for Interviews.

Interview Objectives:

- To explore the experience of primary care practitioners in relation to referral of patients with COPD to pulmonary rehabilitation.
- To gain an understanding of the main perceived barriers and enablers for referring COPD patients for pulmonary rehabilitation.
- To gain insight into whether any patient characteristics influence whether or not people with COPD are referred for pulmonary rehabilitation.

Understanding current behaviour

To start the discussion, participants will be asked to talk about their experiences of managing patients with COPD in primary care and any experience of referral for pulmonary rehabilitation

1/ Could you tell me in what context do you currently see COPD patients? (Exposure to population/target intervention within working role e.g. planned – annual review/flu jab or unplanned - exacerbation)

2/ On average how many COPD patients do you think you see per week?

3/ Do you currently refer to PR programmes?

Capability, Opportunity, Motivation – including External Context

4/ What is your understanding/view surrounding Pulmonary Rehabilitation programs in general? And in relation to your local provider?….

5/ Do you think pulmonary rehabilitation is beneficial for patients? In what ways? Or why not?

6/ How easy or difficult is it for you to refer to your local PR provider?

(Eg. Is it your role to refer? When is it appropriate to refer COPD patients to PR?)

7/ What motivates you to refer patients to PR ?

(Eg. Do patients/carers ever ask you about pulmonary rehabilitation? Does the post PR patient summary motivate you, are you reminded by prompts or other guidance?)

8/ What do you think stops you from referring patients to pulmonary rehabilitation?

Images Alternating images (between 1-4)

9/ If this person was in your COPD patient, would you consider discussing PR with them? Why? Why not?

Future

10/ Is there anything that you think could improve the primary care discussion surrounding PR and/or encourage you to make referrals to PR?

Possible prompts: Do you think a short video clip would help you motivate patients? Or computerised prompts to follow? Or a further telephone call to encourage patients? Or a firm appointment slot to discuss PR with them?

Additional file 2 TDF domain alignment using construct labelling (1)

Domain	Constructs
1.Knowledge (An awareness of the existence of something)	Knowledge (including knowledge of condition /scientific rationale) Procedural knowledge Knowledge of task environment
2. Skills (An ability or proficiency acquired through practice)	Skills Skills development Competence Ability Interpersonal skills Practice Skill assessment
3. Social/Professional Role and Identity (A coherent set of behaviours and displayed personal qualities of an individual in a social or work setting)	Professional identity Professional role Social identity Identity Professional boundaries Professional confidence Group identity Leadership Organisational commitment
4. Beliefs about Capabilities (Acceptance of the truth, reality, or validity about an ability, talent, or facility that a person can put to constructive use)	Self-confidence Perceived competence Self-efficacy Perceived behavioural control Beliefs Self-esteem Empowerment Professional confidence
5. Optimism (The confidence that things will happen for the best or that desired goals will be attained)	Optimism Pessimism Unrealistic optimism Identity
6. Beliefs about Consequences (Acceptance of the truth, reality, or validity about outcomes of a behaviour in a given situation)	Beliefs Outcome expectancies Characteristics of outcome expectancies Anticipated regret Consequents

7. Reinforcement (Increasing the probability of a response by arranging a dependent relationship, or contingency, between the response and a given stimulus)	Rewards (proximal / distal, valued / not valued, probable / improbable) Incentives Punishment Consequents Reinforcement Contingencies Sanctions
8. Intentions (A conscious decision to perform a behaviour or a resolve to act in a certain way)	Stability of intentions Stages of change model Transtheoretical model and stages of change
9. Goals (Mental representations of outcomes or end states that an individual wants to achieve)	Goals (distal / proximal) Goal priority Goal / target setting Goals (autonomous / controlled) Action planning Implementation intention
10. Memory, Attention and Decision Processes (The ability to retain information, focus selectively on aspects of the environment and choose between two or more alternatives)	Memory Attention Attention control Decision making Cognitive overload / tiredness
11. Environmental Context and Resources (Any circumstance of a person's situation or environment that discourages or encourages the development of skills and abilities, independence, social competence, and adaptive behaviour)	Environmental stressors Organisational culture /climate Resources / material resources Salient events / critical incidents Person x environment interaction Barriers and facilitators
12. Social influences (Those interpersonal processes that can cause individuals to change their thoughts, feelings, or behaviours)	Social pressure Social norms Group conformity Social comparisons Group norms Social support Power Intergroup conflict Alienation Group identity Modelling
13. Emotion	Fear Anxiety

(A complex reaction pattern, involving experiential, behavioural, and physiological elements, by which the individual attempts to deal with a personally significant matter or event)	Affect Stress Depression Positive / negative affect Burn-out
14. Behavioural Regulation (Anything aimed at managing or changing objectively observed or measured actions)	Self-monitoring Breaking habit Action planning

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Additional File 3: General Practice Staff experiences of referring patients with COPD to PR

Thank you for taking the time to complete this questionnaire, which aims to gather perspectives from staff working in primary care. This survey is designed for us to find out some of the barriers staff face when considering referring a patient with COPD to PR so please answer the questions as honestly as you can. This should only take you around 15 minutes to complete. First, please complete the following information

Geographical location of practice (please circle)	England North East North West Yorkshire and the Humber East Midlands West Midlands East of England London South East South West Scotland Wales NI
Profession (please circle)	GP/Trainer Practice Nurse ANP Other (ECP/HCP/Pharmacist)
Age (years)	18-29 30- 39 40 – 49 50- 59 60 +
Gender	Female Male
What is your ethnic group? Please circle one option that best describes your ethnic group or background	**White** English Welsh Scottish Northern Irish British Irish Gypsy, Traveller or Irish Traveller Any other White background: **Mixed/ Multiple ethnic groups** White and Black Caribbean White and Black African White and Asian Any other Mixed/ Multiple ethnic background: **Black/ African/ Caribbean/Black British** African Caribbean Any other Black/ African/ Caribbean background **Asian/ Asian British** Indian Pakistani Bangladeshi Chinese Any other Asian background: **Other ethnic group** Arab Any other ethnic group:
Do you see patients with COPD for (please circle as many as relevant)	Acute management Chronic management Both Neither
No. of years in general practice	Years: …….. Months: ……
Respiratory Qualifications	None COPD Diploma Asthma Diploma ARTP Spirometry Other
Do you currently refer patients with COPD to pulmonary Rehabilitation?	Yes - If yes - Weekly Monthly Less than monthly No - if no please explain why ……

This questionnaire is designed to ask you about your experiences with referring (or considering referring) patients with COPD to Pulmonary Rehabilitation and should take no more than **15 minutes** to complete. Please don't spend too long thinking about each question.

The questionnaire is made up of 4 elements. When rating your level of agreement with each phrase, please think about **all the things that might affect you being able to discuss pulmonary rehabilitation with your patients as well as refer.**

Please indicate your level of agreement with the following statements:

Question list	Strongly Disagree	Disagree	Neither disagree nor agree	Agree	Strongly Agree
1. I am aware of the content of Pulmonary Rehabilitation (PR) Programmes	1	2	3	4	5
2. I am aware of PR programme objectives.	1	2	3	4	5
3. I am unsure of the evidence base for PR	1	2	3	4	5
4. I know where geographically my local PR programme is delivered	1	2	3	4	5
5. I know when it is appropriate to refer a patient with COPD to PR	1	2	3	4	5
6. I can answer questions patients have about PR	1	2	3	4	5
7. I know how to contact my local PR provider	1	2	3	4	5
8. My local PR providers regularly engage with me	1	2	3	4	5
9. It is easy to refer a patient to PR	1	2	3	4	5
10. I am confident my local PR provider offers a good service for my patients.	1	2	3	4	5
11. Referral to PR is the practice nurse role	1	2	3	4	5
12. Other General Practice staff in my practice (excluding Practice Nurse) refer patients to PR	1	2	3	4	5
13. Referring patients to PR is something I have been advised to do	1	2	3	4	5
14. I am confident in my ability to encourage patients to attend PR, even when they are not motivated	1	2	3	4	5
15. I do not find it easy to discuss PR with patients.	1	2	3	4	5
16. I don't believe patients will attend PR after I have referred	1	2	3	4	5
17. Patients in work are not able to attend PR	1	2	3	4	5
18. PR is not beneficial to patients who are breathless	1	2	3	4	5
19. Patients who use home oxygen are unable to take part in PR	1	2	3	4	5
20. Patients who smoke are not motivated to take part in PR	1	2	3	4	5
21. Patients without their own transport won't be able to get to PR	1	2	3	4	5
22. Patients who live alone won't like to take part in group PR	1	2	3	4	5
23. I only refer patients if they have quit smoking	1	2	3	4	5
24. I only refer patients if they are optimised on their respiratory medication	1	2	3	4	5

Question list	Strongly Disagree	Disagree	Neither disagree nor agree	Agree	Strongly Agree
25. PR is most suited to COPD patients who have frequent exacerbations	1	2	3	4	5
26. My practice receives financial incentives for referral to PR (Before April 2019)	1	2	3	4	5
27. My practice regularly reviews COPD registers to ensure eligible COPD patients are offered PR	1	2	3	4	5
28. There are set targets within the practice to improve PR referral rates	1	2	3	4	5
29. I often forget to refer patients with COPD to PR	1	2	3	4	5
30. There is not enough time in practice to refer	1	2	3	4	5
31. I believe patients may be harmed by taking part In PR	1	2	3	4	5
32. Prompts to refer patients to PR within annual review templates are important reminders for me	1	2	3	4	5
33. The best time to discuss PR referral with patients is when they are stable.	1	2	3	4	5
34. Patients are motivated to attend PR	1	2	3	4	5
35. PR is best suited to those patients with worsening breathlessness	1	2	3	4	5
36. PR is best suited to those who have frequent exacerbations	1	2	3	4	5
37. I believe in encouraging patients to attend PR	1	2	3	4	5
38. PR reduces hospital admissions	1	2	3	4	5
39. I believe most patients will attend and complete PR following my referral	1	2	3	4	5
40. PR reduces risk of mortality	1	2	3	4	5
41. If patients attend PR this will reduce their general practice visits	1	2	3	4	5
42. PR reduces exacerbations	1	2	3	4	5
43. PR improves breathlessness	1	2	3	4	5
44. PR reduces a patient's anxiety and/or depression.	1	2	3	4	5
45. If I keep pushing patients to attend PR this will disadvantage my relationship with them.	1	2	3	4	5
46. There are good relationships in practice with PR providers	1	2	3	4	5
47. PR providers are good at communicating outcomes of referrals I have made	1	2	3	4	5
48. Resources about PR (i.e written information) are readily available	1	2	3	4	5
49. PR is something that patients ask for	1	2	3	4	5

Question list	Strongly Disagree	Disagree	Neither disagree nor agree	Agree	Strongly Agree
50. I will refer more patients to PR now there are practice QoF incentives (from April 2019)	1	2	3	4	5
51. There will be greater awareness of PR within practices because of the new QoF incentives.	1	2	3	4	5
52. More health care practitioners will discuss PR with patients because of the QoF incentive.	1	2	3	4	5
53. I believe patient attendance to PR will increase because of the QoF Incentive.	1	2	3	4	5
54. I believe the QoF incentive will not increase patients PR attendance	1	2	3	4	5

2/Please consider the interventions below. Please rate each possible intervention based on which you think would be the most helpful in improving your rates of referral to PR?

3/ Then please indicate the top 5 that you think will be the most effective in increasing PR referral within your practice. Please rank them in order 1 (highest) – 5 (lowest) in the 'Rank" column.

Question list	Strongly Disagree	Disagree	Neither disagree nor agree	Agree	Strongly Agree	Rank (1-5)
1. Health Care Professional (HCP) referring patients to PR at the time of COPD diagnosis.	1	2	3	4	5	
2. HCP prescribing PR at the time of COPD acute exacerbation.	1	2	3	4	4	
3. A standardised summary (i.e: a 2 sentences) that describes PR succinctly for HCP to recite to eligible patients.	1	2	3	4	5	
4. Face to face educational sessions for general practice staff.	1	2	3	4	5	
5. Online educational sessions for general practice staff.	1	2	3	4	5	
6. Face to face educational sessions for potential patients, carers and family.	1	2	3	4	5	
7. Online educational sessions for patients, carers & family.	1	2	3	4	5	
8. Practice staff loaning DVDs which demonstrate PR to patients.	1	2	3	4	5	
9. HCP showing patients PR recording within practice or consultation ie on a tablet device.	1	2	3	4	5	
10. Past PR patient attenders directly engage with eligible patients to highlight benefits.	1	2	3	4	5	
11. PR providers directly contacting eligible practice patients.	1	2	3	4	5	

Question list	Strongly Disagree	Disagree	Neither disagree nor agree	Agree	Strongly Agree	Rank
12. PR providers engaging with practice staff by coming into surgeries.	1	2	3	4	5	
13. Personalised letters to eligible patients from general practice advocating PR.	1	2	3	4	5	
14. Group consultations with patients, general practice staff and PR provider.	1	2	3	4	5	
15. Patients being able to refer themselves to PR.	1	2	3	4	5	
16. Patients having their own COPD health care record, similar to a COPD passport, meaning they are prompted to ask for PR.	1	2	3	4	5	
17. PR promotional material within patient pharmacy medication packs	1	2	3	4	5	
18. Greater awareness of PR in practice. i.e Posters highlighting local PR provider, benefits, etc.	1	2	3	4	5	
19. General practice staff being able to refer patients by telephone rather than manually completing referral form.	1	2	3	4	5	
20. If my practice referred more COPD patients this would increase my own referral numbers.	1	2	3	4	5	
21. Changing the name of PR to something more user friendly.	1	2	3	4	5	
22. General practice staff being taught motivational interviewing techniques would improve referral to PR.	1	2	3	4	5	
23. Lead practice PR referrer to educate and show PR video to other practice staff at practice meetings, to encourage a whole practice approach.	1	2	3	4	5	

4/ Please add any further comments/suggestions you may have……

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Many thanks for completing this questionnaire. Please return to the return box to collect your chocolate(s).

Guidelines for Conducting and Reporting Mixed Research for Counselor Researchers (1)

Research Formulation	
1.1.1. Treat each relevant article as data that generate both qualitative (e.g., qualitative findings, literature review of source article, source article author's conclusion) and quantitative (e.g., p values, effect sizes, sample size score reliability, quantitative results) information that yield a mixed research synthesis. 1.1.2. Subject each document selected as part of the literature review to summarization, analysis, evaluation, and synthesis. 1.1.3. Provide literature reviews that are comprehensive, current, and rigorous; that have been compared and contrasted adequately; and that contain primary sources that are relevant to the research problem under investigation, with clear connections being made between the sources presented and the present study. 1.1.4. Present clearly the theoretical/conceptual framework. 1.1.5. Assess the findings stemming from each individual study and the emergent synthesis for trustworthiness, credibility, dependability, legitimation, validity, plausibility, applicability, consistency, neutrality, reliability, objectivity, confirmability, and/or transferability. 1.1.6. Present the goal of the study (i.e., predict; add to the knowledge base; have a personal, social, institutional, and/or organizational impact; measure change; understand complex phenomena; test new ideas; generate new ideas; inform constituencies; and examine the past).	Pages 3/4/5
1.2.1. Specify the objective(s) of the study (i.e., exploration, description, explanation, prediction, and influence). 1.3.1. Specify the rationale of the study. 1.3.2. Specify the rationale for combining qualitative and quantitative approaches (i.e., participant enrichment, instrument fidelity, treatment integrity, and significance enhancement). 1.4.1. Specify the purpose of the study. 1.4.2. Specify the purpose for combining qualitative and quantitative approaches (e.g., identify representative sample members, conduct member check, validate individual scores on outcome measures, develop items for an instrument, identify barriers and/or facilitators within intervention condition, evaluate the fidelity of implementing the intervention and how it worked, enhance findings that are not significant, compare results from the quantitative data with the qualitative findings).	Title & pages 3 & 4 As above

1.5.1. Avoid asking research questions that lend themselves to yes/no responses. 1.5.2. Present mixed research questions (i.e., questions that embed both a quantitative research question and a qualitative research question within the same question) when possible.	
Research Planning 2.1.1. Specify the initial and final sample sizes for all quantitative and qualitative phases of the study. 2.1.2. Present all sample size considerations made for the quantitative phase(s) (i.e., a priori power) and qualitative phases (e.g., information-rich cases). 2.1.3. Present the sampling scheme for both the quantitative and qualitative phases of the study. 2.1.4. Describe the mixed sampling scheme (i.e., concurrent–identical, concurrent–parallel, concurrent–nested, concurrent–multilevel, sequential–identical, sequential–parallel, sequential–nested, and sequential–multilevel). 2.1.5. Clarify the type of generalization to be made (i.e., statistical generalization, analytic generalization, and case-to-case transfer) and link it to the selected sampling design, sampling scheme, and sample size(s). 2.2.1. Outline the mixed research design. 2.2.2. Specify the quantitative research design (i.e., historical, descriptive, correlational, causal–comparative/quasi-experimental, and experimental). 2.2.3. Specify the qualitative research design (e.g., biography, ethnographic, auto-ethnography, oral history, phenomenological, case study, grounded theory)	Pages 4-5
Research Implementation 3.1.1. Outline the mixed data collection strategy. 3.1.2. Present information about all quantitative and qualitative instruments and the process of administration. 3.2.1. Outline the mixed data collection strategy (i.e., data reduction, data display, data transformation, data correlation, data consolidation, data comparison, and data integration). 3.2.2. Provide relevant descriptive and inferential statistics for each statistical analysis.	Pages 5.6.7 Pages 24-26

3.2.3. Discuss the extent to which the assumptions (e.g., normality, independence, equality of variances) that underlie the analyses were met, as well as any observations that might have distorted the findings (e.g., missing data, outliers).	
3.2.4. Specify the statistical software used.	Page 5.7
3.2.5. Specify where the responsibility or authority for the creation of categories resided (i.e., participants, programs, investigative, literature, or interpretive), what the grounds were on which one could justify the existence of a given set of categories (i.e., external, rational, referential, empirical, technical, or participative), what was the source of the name used to identify a given category (i.e., participants, programs, investigative, literature, or interpretive), and at what point during the research process the categories were specified (i.e., a priori, a posteriori, or iterative)	
3.2.6. Specify the name of the technique used to analyze the qualitative data (e.g., content analysis method of constant comparison, discourse analysis, componential analysis, keywords in context, analytic induction, word count, domain analysis, taxonomic analysis).	
3.2.7. Specify the qualitative software used.	
3.3.1. Discuss the threats to internal validity, external validity, and measurement validity and outline the steps taken to address each of these threats to internal validity, external validity, and measurement validity.	Page 5-7, 28-29
3.3.2. Discuss the threats to trustworthiness, credibility, dependability, authenticity, verification, plausibility, applicability, confirmability, and/or transferability of data and outline all verification procedures used.	
3.3.3. Discuss mixed research legitimation types (i.e., sample integration legitimation, insider–outsider legitimation, weakness minimization legitimation, sequential legitimation, conversion legitimation, paradigmatic mixing legitimation, commensurability legitimation, multiple validities legitimation, and political legitimation).	
	Page 18-23,
3.4.1. Interpret relevant types of significance of the quantitative findings (i.e., statistical significance, practical significance, clinical significance, and economic significance).	Not applicable.
3.4.2. Conduct post hoc power analysis for all statistically non-significant findings.	Page 10-17,
3.4.3. Interpret the significance (i.e., meaning) of qualitative findings.	
3.4.4. Discuss criteria for evaluating findings in mixed research studies (e.g., within-design consistency, conceptual consistency, interpretive agreement, interpretive distinctiveness, design suitability, design fidelity, analytic adequacy, interpretive consistency, theoretical consistency, integrative efficacy).	Page 25-26

3.5.1. Describe all steps of the mixed research process. 3.5.2. Describe the context in which the mixed research study took place. 3.5.3. Ensure that the mixed research report is accurate and complete; does not distort differences within and among individuals and groups; is free from plagiarism or misrepresentation of the ideas and conceptualizations of other scholars; and contains findings that are adequately accessible for reanalysis, further analysis, verification, or replication. 3.5.4. Present all ethical considerations that were addressed in the study (e.g., informed consent, confidentiality, incentives, funding sources, potential conflicts of interest, biases). 3.5.5. Specify study approval in accordance with an institutional review board either in the report or in the cover letter submitted to the editor. 3.5.3. Present recommendations for future research that culminate in a validation, replication, or extension of the underlying study.	 Throughout paper. Page 5-6 Throughout paper. Page 5-6 and page 33 Covering letter to the editor Page 30

1. Leech NL, Onwuegbuzi AJ. Guidelines for Conducting and Reporting Mixed Research in the Field of Counseling and Beyond. Journal of Counseling & Development. 2010;88:61-9.