Accuracy of Screening Tests for Chronic Obstructive Pulmonary Disease in Primary Health Care: Rapid Evidence Synthesis

This document is a supplement to the rapid policy brief on the issue.

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Competing interests
The authors do not have any relevant competing interests.

Acknowledgements
This gratis rapid evidence synthesis was made possible due to the support from World Health Organization, Alliance for Health Policy and Systems Research. The funder did not have a role in drafting, revising or approving the content of the policy brief.

The authors would also like to acknowledge and thank Dr Prabir Chatterjee and Mr Narayan Tripathi, State Health Resource Centre, Chhattisgarh, India

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Suggested citation
Tyagi J, Bhaumik S, Kakoti M, Moola S. Accuracy of Screening Tests for Chronic Obstructive Pulmonary Disease in Primary Health Care: Rapid Evidence Synthesis. The George Institute for Global Health, India, May 2020.

List of abbreviations

BOLD –Burden of Obstructive Lung Diseases
CRD –Chronic Respiratory Disorders
COPD –Chronic Obstructive Pulmonary Disease
FEV –Forced Expiratory Volume
GOLD –Global Initiative for Chronic Obstructive Lung Disease
LMICs –Low- and Middle-Income Countries
NICE –National Institute for Health and Care Excellence, UK
PHC –Primary Health Care
PICO –Population, Interventions, Comparisons and Outcomes
PIRD –Population, Index test, Reference test, Diagnosis of interest
RES –Rapid Evidence Synthesis
SHRC –State Health Resource Centre

Executive Summary

The global burden of chronic obstructive pulmonary disease (COPD) continues to increase especially in Low-and Middle-Income Countries (LMIC) posing a substantial threat to public health. Chronic obstructive pulmonary disease remains significantly underdiagnosed, with correct diagnosis commonly missed or delayed until pulmonary impairment is in advanced stages. The State Health Resource Centre (SHRC) in Raipur, Chhattisgarh identified that there is a high burden of COPD in the state, particularly in areas of with high levels of industrial pollution. The Rapid Evidence Synthesis (RES) team of The George Institute for Global Health (TGI) received a request from the SHRC to conduct a rapid review of the existing evidence on improving diagnosis of COPD in primary health care settings.

The primary objective of this RES was to identify and summarize the evidence on accuracy of the screening tests for COPD in primary health care. On initial scoping we found an indexed systematic review by Haroon et al. An updated search was conducted for the existing systematic review in major databases on accuracy of screening tests. Based on a pre-set inclusion criteria, additional, potentially relevant studies titles and abstracts were screened, and irrelevant studies were discarded. Full text articles were obtained for forty-four studies. Five of the forty-four studies were included for data extraction for diagnostic test accuracy.

The RES provides a succinct summary of the existing evidence on diagnostic accuracy of the screening tests. We found that COPD Diagnostic Questionnaire (CDQ) can be considered as a screening tool for detecting air flow limitation in general population. Handheld flow meters when operated under supervision of trained health professionals in addition to questionnaire are likely to be more accurate for COPD screening.

1.Background

Chronic obstructive pulmonary disease is preventable, but it often remains undetected in its mild and moderate forms. According to global burden of disease in India the prevalence of COPD has increased by 39.4% in 2017 posing a significant public health threat. It is the fourth leading cause of years of life lost in Empowered Action Group (EAG) States. (1) COPD is an umbrella term used to describe chronic lung diseases that cause limitations in lung airflow. Patients often remain undiagnosed and untreated until the disease becomes severe and debilitating, negatively impacting their quality of life, economic condition and poses risk of death. (2)

In primary care settings, early diagnosis of COPD is a cumbersome task. Patients in the early stages of COPD are relatively less symptomatic, and hence, they may not be able to provide the required information to health-care providers at an appropriate stage. By the time the disease is brought to clinical attention, it usually reaches an advanced stage, where the forced expiratory volume in 1 second (FEV1) is typically below 50% of predicted value. (3)

The Burden of Obstructive Lung Diseases (BOLD) initiative used a standardised methodology comprising of screening tools like questionnaires and pre-post bronchodilator spirometry to assess the prevalence and risk factors for COPD in people aged 40.(4) Simple screening questionnaires that are easily understandable and can be filled without any supervision are useful tools to identify patients at risk for COPD particularly in primary health care (PHC) settings which are often resource scarce.

The identification of undiagnosed COPD remains an important priority worldwide. Guidelines from National Institute for Health and Care Excellence (NICE, UK) recommend the use of case finding as a strategy in primary care settings to identify early disease by targeting a high-risk asymptomatic population, such as individuals over the age of 35 years, current or ex-smokers, and those having a chronic cough.(5)

The State Health Resource Centre (SHRC) in Raipur, Chhattisgarh requested the Rapid Evidence Synthesis (RES) team at The George Institute for Global Health (TGI) to conduct a rapid review of evidence on improving diagnosis of COPD at PHC level. The centrereported a high burden of COPD in the state, particularly in areas of with high levels of industrial pollution. The overall objective of this RES was to identify and summarise evidence on accuracy of the diagnostic test for COPD among adults aged ≥35 years at PHC level.

Review question

- What is the best available evidence on the diagnostic accuracy of screening tests mainly measured by sensitivity and specificity of the tests for detecting COPD among adults aged ≥35 years at primary health care level?

2.Methods

This section describes the methods used in the development of the rapid review.

Inclusion Criteria (PIRDS) for diagnostic accuracy of screening tests for COPD

Population

Individuals aged ≥35 years with no prior diagnosis of COPD.

Index test

Screening questionnaires, handheld flow meters/handheld spirometer (e.g. Piko-6 or COPD-6), peak flow meters/ micro spirometry, chest radiography, and risk prediction models or decision aids, either alone or in combination.

Reference

Presence of airflow obstruction measured based on pre-bronchodilator or post-bronchodilator spirometry.

Diagnosis of interest

Identification of COPD.

Study designs

Systematic reviews supplemented with more recent primary studies of any design conducted in primary care

Setting

Studies conducted in primary health care context were considered.

Search methods

A systematic review (6) published in 2015 addressed the review question of interest. It provided relevant details from included studies on diagnostic accuracy of screening tests for identifying undiagnosed COPD till 2014. Hence, we updated the systematic review (6) by searching for primary studies of any design that evaluated screening tests conducted in primary care. We searched in two electronic databases (PubMed and EMBASE). The search was restricted to studies published in the English language.
The following key search terms and related synonyms were used to identify and retrieve potentially relevant studies.

Box 1: Comprehensive list of search terms utilised in various databases

"Chronic obstructive pulmonary disease" OR "Chronic obstructive lung disease" OR "chronic obstructive airways disease" OR "COPD" OR "COAD" OR "Emphysema" OR "Chronic bronchitis" OR "Airflow obstruction" OR "Airflow limitation"

AND

"Case finding" OR "Screening" OR "early detection" OR "Secondary prevention" OR "Spirometry" OR "Questionnaire" OR "Peak flow" OR "Chest X-ray" OR "Sensitivity" OR "Specificity" OR "Decision aid" OR "Algorithm"

AND

Primary Health Care*

Study selection, data collection, and reporting

Selection of studies

The titles and abstracts of studies for inclusion were screened. This enabled retrieval of full texts of eligible studies for a full text examination and selection. The primary reviewer independently applied the inclusion criteria to the retrieved publications.

Data extraction and management

Data from included reviews were extracted using a pre-designed template. A primary reviewer independently extracted all relevant outcome data, with random verification of the data done by a secondary reviewer. The data of interest included:

- Study type
- Countries where studies were conducted
- Participants (number) and details of setting
- Index and reference test
- Intervention (screening tests and their details)
- Outcome measures
- Results

Data Synthesis

Relevant outcome data were extracted and tabulated from selected reviews. A narrative synthesis summary was presented that addressed the review question documenting relevant data and findings.

3.Results

This section provides a summary of the diagnostic accuracy of various screening tests for detecting COPD in primary health care settings.

Description of studies

Search results and study selection

Searches of the mentioned electronic databases were conducted in March 2020. The searches identified 7007 citations from which one duplicate was discarded. Figure 1 depicts the study selection process in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram. Initially we commenced with synthesising evidence from ten studies of the systematic review by Haroon et al. (6) Based on the pre-set inclusion criteria, additional, potentially relevant study titles and abstracts were screened, and irrelevant studies were discarded. Full text articles were obtained for forty-four studies. The studies were reviewed to check for relevance for each domain of interest. The inclusion and exclusion criteria were applied for the full texts as well. Only five of the forty-four studies were included in the final report.

Characteristics of the included studies

Overall fifteen studies (7-21) were included in the RES, which were cross-sectional diagnostic test accuracy studies. Out of them four (10,15,18,19) used a paired design and compared two screening tests (screening questionnaires and handheld flow meters) while the remaining studies used single screening method followed by spirometry as reference test. The characteristics of the included studies are summarised in Table 1**.**

Index and Reference tests

One or more index tests were performed on the eligible population prior to applying reference test (diagnostic spirometry). Index tests included screening questionnaires (n=13) (7,9-15,17-21), handheld flow meters (n=6) (8,10,15,16,18,19) Four studies (10,15,18,19) assessed the combined accuracy of using handheld flow meter along with questionnaire. Pre and post bronchodilator spirometry was used as the reference standard test.

Screening questionnaire

Overall four screening questionnaires i.e. COPD Diagnostic Questionnaire (CDQ), Lung Function Questionnaire (LFQ), COPD Population Screener (COPD-PS) and Two screening questions (2SQ) were assessed on 15,182 participants in thirteen studies. (7,9-15,17-21) Few studies (17,18,20) reported using more than one questionnaire as their screening tool. Characteristics of studies evaluating screening questionnaires are summarised in **Table 2.**

COPD Diagnostic Questionnaire (CDQ) was the most extensively used screening tool (n=8) (10,12,14,15,17,18,20,21) amongst all the questionnaires. The CDQ is also referred to as the Respiratory Health Screening Questionnaire (RHSQ) or International Primary Care Airways Group (IPAG) questionnaire.

Out of the eight studies evaluating CDQ involving ever smoker participants, four studies (10,12,14,15) qualified for conducting meta-analysis. The heterogeneity in threshold of score of the remaining studies, resulted in their preclusion from conducting a meta-analysis. Using a score threshold of ≥19.5, the pooled sensitivity was 64.5% (95% Confidence Interval (CI) 59.9% to 68.8%) and specificity 65.2% (95% CI 52.9% to 75.8%). The pooled sensitivity was higher at 87.5% (83.1 to 90.9) for the score threshold of ≥ 16.5, but the specificity was quite low at 38.8% (27.7 to 51.3). In the four studies excluded from meta-analysis, the sensitivities ranged from 36% to 80% and specificities from 47% to 93%

Other screening questionnaires: Lung Function Questionnaire (LFQ), COPD Population Screener (COPD-PS) and Two screening questions (2SQ). All the other screening questionnaires reported a significant heterogeneity in their design, and therefore were not eligible to be included in a meta-analysis. In these eight (7,9,11,13,17-20,) studies, sensitivities ranged from 20% to 93% and specificities from 25% to 90%.

Handheld flow meter

Five studies (8,10,15,16,18,19) evaluated the diagnostic accuracy of handheld flow meter in 2052 participants. The mean age of the participants ranged from 52–65.3

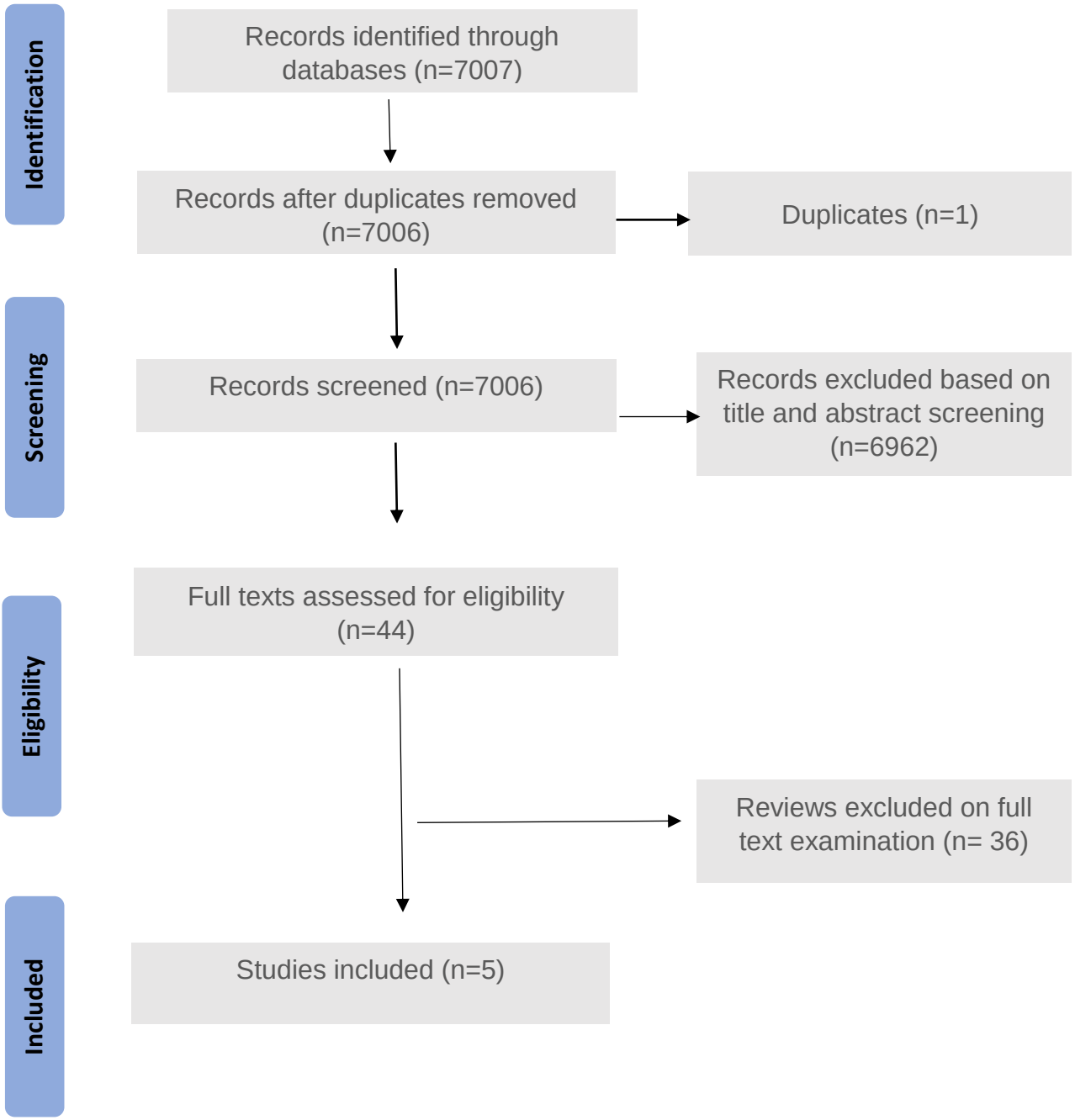
years. Handheld flowmeter is a device intended for measuring lung function. FEV1 and FEV6 is a measure of forced expiratory volume in 1 and 6 seconds respectively. The test is repeated three times with the highest values recorded. Four studies (8,10,16,18,19) used it without a bronchodilator. COPD6 and PICO-6 are handheld meters which were operated by general practitioners, nurses or technicians. An FEV1/FEV6 cut off < 0.7 provided a range of sensitivity from 79% to 87.9% and specificity from 71% to 99% for COPD screening. Characteristics of studies evaluating handheld flow meters are summarised in **Table 3.**

Meta-analysis was performed in three studies (10,15,16) because of their homogeneity and enrolling ever-smokers as participants. The pooled sensitivity was 79.9% (95% CI 74.2% to 84.7%) and specificity was 84.4% (95% CI 68.9% to 93.0%) **(Table 4).**

Combination of tests

Four studies (10,15,18,19) evaluated the combined diagnostic test accuracy of a handheld flow meter along with a questionnaire. Of the four studies only two studies (15,19) reported the combined accuracy. Sichletidis et al (15) reported the combined accuracy of a screening questionnaire (CDQ) with a handheld flow meter. The sensitivity was 74% (95% CI 64% to 83%) and specificity was 97% (95% CI 95% to 98%). Similarly, Shirley et al. (19) reported combined test accuracy for screening questionnaire (COPD-PS) and handheld flow meter. The tests together yielded a sensitivity of 20% and specificity of 92.9%.

Figure 1 PRISMA Study Selection Flow Chart



Summary of the findings

Fifteen studies were included in the review that examined the evidence on diagnostic accuracy of screening tests mainly measured by sensitivity and specificity of the test for detecting COPD. These studies involved over 35,429 participants, with the mean age ranging from 49 years to 69.5 years. All the studies included were of cross-sectional diagnostic test accuracy design conducted in developed countries like UK, US, Australia, European countries except one (8) which was conducted in Vietnam.

The findings of meta-analysis evaluating CDQ involving ever smokers suggests the likelihood ratio tests that the CDQ at a score threshold of ≥19.5 had a lower sensitivity (p=0.003) but no difference in specificity (p=0.09) compared with handheld flow meters. In the second analysis at the lower score threshold of ≥16.5 (or 17), the evidence suggests a higher sensitivity (p=0.03) but a much lower specificity (p=0.01) than handheld flow meters.

For the combined tests, Frith et al and Llordes et al (10,18) reported higher sensitivity and specificity (Sn=81%, Sp=71% and Sn=87.9%, Sp=72.3% respectively) of handheld flow meter as compared to the CDQ screening questionnaire (Sn=73%, Sp=62% and Sn=73.8%, Sp=56% respectively) when operated under the supervision of trained nurses or general practitioners. These results are consistent with the results from meta-analysis. Likewise, Shirley et al reported a higher sensitivity and specificity of handheld flow meter (80% and 79.8% respectively) as compare to COPD-PS questionnaire (20% and 78.6% respectively).

Overall evidence suggests that handheld flow meters administered under the supervision of trained health professionals in addition to COPD questionnaires are likely to be more accurate in detection of undiagnosed COPD. A combination of both screening methods may improve the accuracy further, thereby potentially reducing the number of diagnostic assessments required.

Table 1: Characteristics of included studies

Study	Country	Setting	Recruitment method	Eligibility criteria	Index and reference tests	Definition of COPD
Buffels[7] 2004	Belgium	20 general practitioners	Invited patients routinely attending general practice over a 12-week period in 1999.	Inclusion criteria: Age 35-70 years Exclusion criteria: Receiving bronchodilators and/or inhaled corticosteroids	Index test: Screening questionnaire Reference test: Pre-BD spirometry in all subjects with respiratory symptoms and 10% sample of asymptomatic subjects	Pre-BD FEV1/FVC<88.5% predicted for men & FEV1/FVC<89.3% for women
Duong-Quy[8] 2009	Vietnam	12 primary care medical centres in one city	Broadcast an advertisement on the local television daily for one week. A recruitment company was used to help with participant recruitment (details not reported). Eligible subjects expressing an interest in participating were advised to attend one of the 12 primary care centres from January 2007 to February 2008.	Inclusion criteria: Active and former smokers with >10 pack-years and aged >40 years Exclusion criteria: Previously diagnosed respiratory disease (asthma, COPD and tuberculosis)	Index test: Pre-BD handheld flow meter (Piko-6®) Reference test: Full medical assessment including clinical examination, pulmonary radiology, ECG, and post-BD spirometry for those who had an index FEV1/FEV6<0.7 and a sample of those with FEV1/FEV6≥0.7	Post-BD FEV1/FVC<0.7 with <200mL or 12% reversibility
Casado[17] 2015	Spain	Primary care centre	Random sampling of a general population	Inclusion criteria: Population aged between 40 to 75 years	Index test: Screening questionnaire Reference test: Post BD Spirometry on all subjects	Post-BD Ratio of FEV1/FVC (forced expiratory volume in 1 second/ forced vital capacity) of <0.7

Freeman[9] 2005	UK	One general practice	Postal invitation from October 1997 to April 2002.	Inclusion criteria: Age ≥40 years & current/ex-smoker & had either received respiratory medications in the preceding 2 years or had a history of asthma Exclusion criteria: None	Index test: Screening questions Reference test: Pre-/ post-BD spirometry on all subjects	Post-BD FEV1/FVC<0.7 and lack of reversibility (reversibility defined as increase in FEV1 of 200mL and 15% from pre-BD FEV1 (not clear if all were post-BD)
Frith[10] 2011	Australia	4 primary care practices	Recruited during routine practice visits, invitation to study days, and local newspaper advertisement between August and December 2006.	Inclusion criteria: Age ≥50 years & current/ex- smoker & no prior diagnosis of obstructive lung disease (COPD, emphysema, chronic bronchitis, asthma) & no treatment for obstructive lung disease in past 12months Exclusion criteria: Refusal or inability to give consent, pre-existing non-obstructive lung disease, symptoms suggestive of unstable heart disease, and spirometry contraindications	Index test: Pre-BD handheld flow meter (Piko-6®) & screening questionnaire (COPD Diagnostic Questionnaire) Reference test: Pre-/ post-BD spirometry on all patients	Post-BD FEV1/FVC<0.7

Hanania[11] 2010	US	Two family physician group offices	Invited patients aged ≥40 years visiting the practices from March-May 2008	Inclusion criteria: Age ≥40 years Exclusion criteria: None	Index test: Screening questionnaire (Lung Function Questionnaire) Reference test: Pre-BD spirometry	Pre-BD FEV1/FVC<0.7
Kotz[12] 2008	Netherlands	General population and primary care practices	Advertisements in a local newspaper, flyers, posters and mailings to households and invitation during primary care consultations from Jan 2005-Dec 2006.	Inclusion criteria: Age 40-70 years & current smoker with ≥10 pack years & motivated to stop smoking & able to read and speak Dutch & reporting a respiratory symptom (cough, phlegm or dyspnoea) Exclusion criteria: Prior respiratory diagnosis, spirometry in previous 12 months or contraindications to smoking cessation therapy	Index test: Questionnaire (COPD Diagnostic Questionnaire) Reference test: Pre-/post-BD spirometry in all participants	Post-BD FEV1/FVC<0.7
Llordes[18] 2016	Spain	8 primary care centres	Active, Patient who attended the primary care centre for any reason during the study period were invited to participate.	Inclusion criteria: Subjects over the age of 40 years who were smokers or ex-smokers of at least 1 pack-year with no previous diagnosis of COPD and who attended the	Index test: Screening questionnaire (CDQ/Respiratory Health Screening Questionnaire (RHSQ) COPD-population screener (PS) Two screening questions (2SQ));	Post-bronchodilator FEV1/FVC <0.7

				Primary Care centres for any reason.	Handheld spirometer (Vitalograph COPD-6) Reference test: Pre and Post BD Spirometry	
Mintz[13] 2011	US	36 primary care centres	NR	Inclusion criteria: Age ≥30 years old & current/ex- smoker with ≥10 pack years Exclusion criteria: Regular use of respiratory medications within 4 weeks of the study, known diagnosis of substantial lung conditions with regular use of respiratory medications.	Index test: Screening questionnaire (Lung Function Questionnaire) Reference test: Pre-/ post-BD spirometry	LFQ≤18 & post-BD FEV1/FVC<0.7
Price1[4] 2006	UK & US	2 primary care practices	Postal invitation	Inclusion criteria: Age ≥40 years & current/ex-smoker Exclusion criteria: Refusal to consent, history of non-obstructive lung disease, use of respiratory medications in past year, acute symptoms of unstable heart disease	Index test: Screening questionnaire (COPD Diagnostic Questionnaire) Reference test: Pre-/post-BD spirometry	Post-BD FEV1/FVC<0.7
Shirley[19] 2015	Japan	2 HIV primary care clinics	Subjects were recruited via referral from	Inclusion criteria:	Index test: Screening questionnaire (COPD-PS); Peak flow meter	Post-BD FEV1/FVC <0.7

			clinic providers and staff, and via response to flyers posted in the waiting rooms.	Patients who met inclusion criteria (age ‡ 35 years with documented HIV infection) were screened for entrance to the study.	(Vitalograph asma-1 electronic peak flow meter) Reference test: Pre and Post BD Spirometry	
Sichletidis[15] 2011	Greece	25 general practices	Invited first 50 patients meeting the inclusion criteria who visited each participating GP from 1st March-31st May 2009.	Inclusion criteria: Age >40 years Exclusion criteria: Confirmed diagnosis of lung disease, thoracic surgery in previous 6 months, acute respiratory infection, uncontrolled cardiac disease, or could not perform acceptable spirometry	Index tests: 1. Screening questionnaire (International Primary Airways Group Questionnaire, also known as the COPD Diagnostic Questionnaire) 2. Post-BD handheld flow meter (Piko-6®) (Bronchodilator=400μg salbutamol) Reference test: Pre-/post-BD spirometry	Post-BD FEV1/FVC<0.7
Spyratos[20] 2016	Greece	Primary care clinics	The general population were invited to participate in the present study by advertisement posters that had been distributed across a network of primary care practices in the city	Inclusion criteria: Participants eligible for this cross-sectional study were subjects aged >40 years, current and former smokers (≥ 10 pack-years).	Index test: Screening questionnaire (CDQ/International Primary Care Airways Group (IPAG) questionnaire; COPD Population Screener (COPD-PS) questionnaire ;	Post-BD FEV 1 /FVC <0.7

				Exclusion criteria: A previous medical diagnosis of bronchial asthma or chronic pulmonary disease other than COPD (e.g., bronchiectasis, lung cancer, tuberculosis, and interstitial lung disease).	Lung Function Questionnaire (LFQ)) Reference test: Pre and Post BD Spirometry	
Stanley[21] 2014	Australia	36 general practices	Patients aged 40–85 years who were former or current smokers with no previous diagnosis of COPD or other obstructive lung disease were invited to a case-finding appointment with a practice nurse in one of the 36 study general practices.	Inclusion criteria: Patients aged 40–85 years who were former or current smokers with no previous diagnosis of COPD or other obstructive lung disease.	Index test: Screening questionnaire (COPD Diagnostic Questionnaire (CDQ)) Reference test: Pre and Post BD Spirometry	post-BD forced expiratory volume in one second/forced vital capacity (FEV1/FVC) ratio <0.7,
Thorn[16] 2012	Sweden	21 primary healthcare centres	Invited patients attending participating primary healthcare centres over a 5-month period.	Inclusion criteria: Age 45-85 years & current/ex-smoker with ≥15 pack years Exclusion criteria: None	Index test: Pre-BD handheld flow meter (COPD-6) Reference test: Pre-/post-BD spirometry	Post-BD FEV1/FVC<0.7
BD, bronchodilator; COPD, chronic obstructive pulmonary disease; FEV1, forced expiratory volume in 1 s; FVC, forced vital capacity; CDQ, COPD Diagnostic Questionnaire; COPD-PS, COPD Population Screener questionnaire; LFQ, Lung Function Questionnaire; IPAG, International Primary Airways Group						

Table 2: Characteristics of studies evaluating screening questionnaires

Characteristic		Range/number of studies
Study designs	Cross-sectional test accuracy	13
Participants		235-3234
Mean age (years)		49–65.3
Male (%)		38.1–83.0
Required smoking status	Only current/ex-smokers	10
	Included never-smokers	5
Required respiratory symptoms		1
Setting	General practice(s)	9
Number of centres	Multicentre	11
	Single centre	2
Recruitment strategy	Active	5
	Opportunistic	4
	Active and opportunistic	2
	Not reported	2
Questionnaires	COPD Diagnostic Questionnaire*	8
	Lung Function Questionnaire	4
	COPD Population Screener (COPD-PS)	3
	Two screening questions (2SQ)	1
	Not named	1
Common items	Age	8
	Smoking status	8
	Respiratory symptoms	8
	Allergies	5
Reference test—spirometry		

Post-BD		9
Definition of airflow obstruction	Post-BD FEV1/FVC <0.7	7
	Other†	1
Included symptoms in definition of COPD		1
Spirometry quality control	Yes	9
Range of results		
Sensitivity		20–93%
Specificity		25–93%
Severity of new COPD cases	≥80%	8.4–39%
(FEV1% predicted) ‡		
	50–80%	43–61%
	<50%	10–37%

*Also referred to as the Respiratory Health Screening Questionnaire and the IPAG questionnaire.

†Pre-BD FEV1/FVC <88.5% predicted for men and FEV1/FVC <89.3% for women.

‡Based on six studies.

BD, bronchodilator; COPD, chronic obstructive pulmonary disease; FEV1, forced expiratory volume in 1 s; FVC, forced vital capacity; IPAG, International Primary Airways Group.

Table 3: Characteristics of studies evaluating handheld flow meters

Characteristic		Range/number of studies
Study designs	Cross-sectional test accuracy	6
Participants		305–2464
Mean age (years)		52.0–65.3
Male (%)		43.3–99.7
Required smoking status	Only current/ex-smokers	4
	Included never-smokers	2
Required respiratory symptoms		0
Setting	General practice(s)	4
Number of centres	Multicentre	6
Recruitment strategy	Active	2
	Opportunistic	2
	Active and opportunistic	2
Handheld flowmeter		
Device	Pico 6	3
	COPD-6	2
	Vitalograph asma-1	1
Operator	Nurse	3
	GP	2
	Not reported	1
Use of BD	Pre-BD	5
	Post-BD	1
Test threshold	FEV1/FEV6<	0.70–0.78
Reference test—spirometry		
Post-BD		6
Definition of airflow obstruction	Post-BD FEV1/FVC <0.7	6
Included symptoms in definition of COPD		0
Spirometry quality control	Yes	2
	No	1
	Unclear	3

Range of results		
Sensitivity		79%–87.9%
Specificity		71%–99%
Severity of new COPD cases	≥80%	35–48%
(FEV1% predicted)		
	50–80%	48–65%
	<50%	0–16%

BD, bronchodilator; COPD, chronic obstructive pulmonary disease; FEV1, forced expiratory volume in 1 s; FVC, forced vital capacity; GP, general practitioner.

Table 4: Summary estimates of the Meta-analysis (pooled result) with Pre and Post bronchodilator spirometry as reference test for "ever smokers"

Index test	Studies	Participants	Sensitivity (95% CI)	Specificity (95% CI)	PPV (95% CI)	NPV (95% CI)	NNS (95% CI)	NND (95% CI)
CDQ (score ≥19.5)	3	495/1703	64.5 (59.9 to 68.8)	65.2 (52.9 to 75.8)	9.7 (6.9 to 14.2)	96.9 (95.8 to 97.7)	29 (26 to 31)	11 (7 to 15)
CDQ (score ≥16.5)	4	580/2322	87.5 (83.1 to 90.9)	38.8 (27.7 to 51.3)	7.7 (6.3 to 9.8)	98.2 (96.6 to 99.0)	21 (20 to 22)	13 (11 to 16)
Handheld flow meters	3	224/1133	79.9 (74.2 to 84.7)	84.4 (68.9 to 93.0)	23.0 (12.2 to 41.3)	98.6 (97.9 to 99.1)	23 (22 to 24)	5 (3 to 9)
COPD, chronic obstructive pulmonary disease; CDQ, COPD Diagnostic Questionnaire; NND, number needing a diagnostic assessment to identify one with COPD; NNS, number-needed-to-screen to identify one with COPD; NPV, negative predictive value; PPV, positive predictive value.								

4.Key policy considerations

- Screening for COPD in primary healthcare should be promoted and appropriate training provided.
- The COPD Diagnostic Questionnaire (CDQ) might be considered as a screening tool for detecting air flow limitation in general population and facilitate early diagnosis. Those with a high score (>16.5 or 17) should undergo confirmatory test.
- Use of handheld flow meters under the supervision of trained health professionals in addition to COPD questionnaire is likely to improve accuracy in detection of undiagnosed COPD but leads to additional resource investment.
- Provision for pre and post bronchodilator spirometry as a confirmation test for all the suspected cases of COPD in a Primary Healthcare centre is essential

5.Recommendations for future research

There is a need for embedded research within the context to evaluate the accuracy of the screening tests for COPD. It is also imperative to assess the cost effectiveness of the screening tests in order to implement the program in resource scarce settings like primary health care centres.

6.Strengths and limitations of the review

The strength of this RES is that it is the first of its kind to examine the evidence on improving diagnosis for treatment of COPD among adults aged ≥35 years at PHC level. The review is an update of existing systematic review conducted by Haroon et al. (6). It was comprehensive in terms of the robust search strategies employed. Further, the reviewers engaged with stakeholders, including content experts throughout the RES process.

This RES is limited by only considering published primary studies in the review and not identifying grey/unpublished literature. It may however have provided important and relevant insights, somewhat limiting our ability to asses risk of bias.

7. Next steps

In order to apply the above study findings in Chhattisgarh, further dialogue and engagement with relevant actors, such as health care providers will be essential. This may be enabled by the dissemination and discussion of the related the content

in this supplement and the associated policy brief with such actors and stakeholders followed by the creation of a workplan.

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