Accuracy of screening tests for chronic obstructive pulmonary disease in primary health care: rapid evidence synthesis

Key Policy Considerations

Chronic obstructive pulmonary disease (COPD) is a preventable disease, but often remains undetected in its mild and moderate forms. The mild nature of symptoms in the early phase often leads to diagnosis being missed or delayed. Administering simple screening tools (e.g., questionnaires, hand-held spirometers, peak flow meters) that have been validated in the primary care setting can be beneficial to detect undiagnosed COPD cases. Policy considerations related to accuracy of the screening tests for COPD in primary health care settings are:

1. Screening for COPD in primary healthcare should be promoted and appropriate training provided.
2. 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.
3. 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
4. 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

What is a rapid evidence synthesis?

A rapid evidence synthesis is a rapid review of global evidence in a **systematic manner to inform decision-making contextualised to context**. These are on-demand and with reference to a specific health policy and systems decision. This **rapid evidence synthesis updates an existing systematic review to provide contextual policy and practice considerations.**

Why was this rapid evidence synthesis conducted?

This was prepared on request from the **State Health Resource Centre (SHRC) Chhattisgarh** to inform and develop **a workplan on improving diagnosis of COPD in primary health care settings.**

Suggested citation

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Background

Chronic obstructive pulmonary disease (COPD) is a common, preventable disease characterised by persistent respiratory symptoms and airflow limitation[1]. An estimated 328 million population have COPD in 2017 worldwide.[2] 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[3]. The primary cause of COPD is exposure to tobacco smoke (either active or passive), while other risk factors include exposure to outdoor and indoor air pollution caused by cooking with solid fuels, occupational dusts and allergens[1].

Patients in the early stages of COPD often have relatively mild symptoms. Primary care providers can frequently miss opportunities to diagnose COPD. As such, better approaches for finding undiagnosed COPD patients and accurate screening tests in primary healthcare is crucial to address the issue. Screening tests are widely used for identifying unrecognized disease in apparently healthy and asymptomatic population thereby reducing the risk of potential health. An ideal screening test would yield a positive result only if the subject has the disease condition (sensitivity or true positive) that's being tested for and a negative result only if the subject does not have the disease (specificity or true negative). However, sensitivity and specificity exist in a state of balance. Increased sensitivity usually comes at the expense of reduced specificity and vice versa. As such a screening test should have a high sensitivity while a confirmatory test should have very high specificity.

The State Health Resource Centre (SHRC) in Raipur, identified that there is a high burden of COPD in Chhattisgarh, particularly in areas with high levels of industrial pollution. The SHRC, Chhattisgarh requested the Rapid Evidence Synthesis (RES team) to conduct a review of the existing evidence on effectiveness of different case finding approaches and accuracy of screening tests for COPD in primary health care.

Methodology

On initial scoping search, we found and updated an existing systematic review on accuracy of screening tests[4]. We conducted a narrative synthesis aided by charting of data to analyse the data extracted. Further details on the methodology is presented in the technical supplement document.

Summary of the evidence on the accuracy of screening tests for COPD

The existing systematic review on accuracy of screening tests by Haroon et al performed the search till 2014 and had included ten studies. For the RES update we found five new studies and thus included fifteen studies[5-19] involving 35,429 participants which provide evidence on the accuracy of the screening tests for COPD. Four studies[8,13,16,17] used a paired design and compared two screening tests, while the remaining studies used single screening method followed by spirometry as reference test.

Index tests included screening questionnaires (n=13)[5,7-13,15-19], handheld flow meters (n=6)[6,8,13,14,16,17]. Pre and post bronchodilator spirometry was used as the reference standard test. COPD Diagnostic Questionnaire (CDQ) was the most extensively used screening tool (n=8)[8,10,12,13,15,16,18,19] amongst all the questionnaires.

Table 1: Accuracy of Different Diagnostic Tests for COPD [5-19]:

Screening test	Sensitivity (95% CI)*	Specificity (95% CI)*	PPV (95% CI)*	NPV (95% CI)*	NNS OR NND* (95% CI)
Narrative Synthesis with Pre and Post bronchodilator spirometry as reference test in adults >35 years					
CDQ (using a score threshold <19.5)[15]	36 (11 to 61)	93 (89 to 96)	NR	NR	NR
CDQ (using a score threshold ≥19.5)[8,10,,12,19]	59% -73% (51 to 83)	54%-77% (49 to 80)	NR	NR	NR
CDQ (using a score threshold ≥16.5 or ≥17)[8,10,,12,13,16,18,19]	73.8%- 93% (69 to 98)	24%- 57% (20 to 61)	NR	NR	NR
COPD-PS (using a score threshold ≥4 or ≥5)[16,17,18]	20% - 80.4%	47.7%-90%	5.3% -41%	87.2%-94.3%	NR
LFQ (using a score of ≤18)[9,11,15,18]	79%-93% (75 to 106)	25%- 71% (21 to 77)	NR	NR	NR
Other unnamed questionnaires[5,7]	57%-87% (50 to 94)	71%-80% (66 to 81)	NR	NR	NR

Handheld flow meters[6,8,13,14,16,17]	79%-87.9% (68 to 90)	71%-99% (63 to 99)	NR	NR	NR
CDQ and handheld flow meter[13,] used together	74.4 (64.2 to 83.1)	97.0 (95.2 to 98.3)	59.1 (43.8 to 74.0)	98.5 (97.9 to 99.0)	NNS-25 (22 to 29); NND-2 (2 to 3)
COPD-PS and handheld flow meter[17] used together	20%	92.9%	14.3%	95.1%	NR
Meta-analysis (pooled result) with Pre and Post bronchodilator spirometry as reference test for "ever smokers"					
CDQ (using a score threshold ≥19.5)[8,10,12]	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)	NNS-29 (26 to 31); NND- 11 (7 to 15)
CDQ (using a score threshold ≥16.5 or >17)[8,10,12,13]	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)	NNS-21 (20 to 22); NND- 13 (11 to 16)
Handheld flow meters[8,13,14]	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)	NNS-23 (22 to 24); NND-13 (11 to 16)

NR- Not Reported
***Sensitivity** –ability of a test to correctly identify those with the disease (true positive)
Specificity - ability of the test to correctly identify those without the disease (true negative)
PPV-Positive Predictive Value- Chances that participants with a positive test truly have the disease
NPV- Negative Predictive Value- Chances that participants with a negative test truly don't have the disease.
NND- Number needed to diagnose- number of patients needing a diagnostic assessment to identify one patient with COPD (the lower the number better the yield)
NNS- Number needed to screen - number of individuals who -needed-to be-screen to identify one patient with COPD (the lower the number better the yield)
CDQ- COPD Diagnostic Questionnaire is also referred as the International Primary Airways Group **(IPAG)** Questionnaire or Respiratory Health Screening Questionnaire **(RHSQ).** It is an 8-item tool designed by the COPD Questionnaire Study Group from a cross-sectional study of primary care patients ⩾40 years old from the United Kingdom and the United States with a history of smoking but no prior respiratory diagnosis. It could be used as a filtering tool to select patients at high risk of COPD to undergo spirometry[19].
COPD-PS- COPD Population Screener developed by a clinician working group in the United States, is a five-item, self-administered questionnaire that was validated for screening individuals in the general population who are at high risk of COPD. It is composed of three COPD-related items (breathlessness, productive cough, and activity limitation) and one question, each regarding smoking history and age[20].
LFQ The Lung Function Questionnaire (LFQ) is a simple, brief, self-administered instrument, being developed to address the need for a screening tool to identify patients appropriate for COPD spirometry-confirmed diagnostic evaluation. It is a five-item tool with a cut point score of ≤18[21].

A COPD diagnostic questionnaire (CDQ) using a score threshold ≥16.5 or >17 presents a comparative high sensitivity both in pooled[8,10,12,13] result for ever smokers and among the adults >35 years[8,10,12,13,16,18,19] as compare to a different score threshold of CDQ and other questionnaires (As summarised in Table:1). Similar value is reported for the Lung function questionnaire[9,11,13,18] thereby, suggesting a lower percentage of missed positive cases. Likewise, the pooled NPV of CDQ reports a 98.2% probability that the subject with negative result is truly free of disease. This implies that the use of a simple, validated, easy to administer tool without requiring much assistance is an effective method to facilitate early recognition of patient at a risk of COPD in PHCs.

Handheld flow meters[8,13,14] reported a pooled high sensitivity of 79.9% and an NNV 98.6 % in ever smokers and 87.9% in adults with age >35 years[6,8,13,14,16,17] when used under the supervision of trained nurses and health professionals. Similarly, a combination of handheld flow meter with CDQ questionnaire[13] yielded a specificity of 74.4% and an NNV of 98.5% suggesting that when used together the screening tests are likely to improve the diagnostic accuracy thereby increasing the detection of undiagnosed COPD and potentially reducing number of diagnostic assessments required. However, this is to be considered that using instrument like handheld flow meter requires precision and training of the health professionals, demanding extra resource which can be a drawback for a resource scarce setting like PHCs.

Implications 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.

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Competing interests

The authors do not have any relevant competing interests.

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