

# Implementation of targeted screening for lung cancer in a high-risk population within routine NHS practice using low-dose computed tomography

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## ABSTRACT

We report a primary care-based lung cancer targeted screening programme using low-dose CT (LDCT) in South Tyneside and Sunderland. Ever smokers with  $\geq 10$  pack-years aged 55–74 years were identified at annual COPD review. 925 individuals attended for LDCT. 2% ( $n=19/925$ ) had lung cancer diagnosed. 66.7% ( $n=14/21$ ) had early stage disease and 78.9% ( $n=15/19$ ) were offered treatment with curative intent. 79.3% of individuals attending for LDCT were ranked in the lowest deprivation quintiles. This approach has been successfully established in routine NHS practice; it is effective with improvements in stage of disease and engages individuals in deprived areas.

## INTRODUCTION

Public Health England data show that the North East and Cumbria have the second highest age- and sex-standardised incidence and mortality of lung cancer.<sup>1</sup> Lung cancer and chronic respiratory disease contribute greatly to the life expectancy inequality gap, only behind heart disease in both sexes. People in the most deprived areas are more than twice as likely to die prematurely (age  $< 75$ ) from cancer.<sup>2</sup> They are also less likely to participate in screening for lung cancer.<sup>3</sup> The NHS Atlas of Variation in Healthcare suggested that, to reduce premature mortality from cancer, commissioners need to support cancer prevention initiatives including cancer screening programmes.<sup>4</sup>

Airflow obstruction has been identified as an independent risk factor for the development of lung cancer,<sup>5</sup> and the addition of emphysema to screening criteria has improved lung cancer detection rates.<sup>6</sup> The National COPD Audit Programme (2016) suggested that 89.3% of patients in the North of England attended primary care review within the preceding 12 months.<sup>7</sup> This has the potential to be a suitable group to target screening.

South Tyneside Clinical Commissioning Group (CCG) and South Tyneside NHS Foundation Trust therefore commissioned a new targeted screening programme for individuals attending annual COPD review in general practice offering low-dose CT (LDCT).

## METHODS

The eligibility criteria and participant journey is described in figure 1. Individuals were ineligible if they were housebound, had a CT chest in the last 12 months or had symptoms needing a 2-week wait referral.

A feasibility pilot project was done and subsequently rolled out across South Tyneside and Sunderland CCGs. Training and written guidelines were provided. Eligible individuals were identified by practice nurses.

All LDCTs are performed out of hours (unless individuals request otherwise) at a cost of £94 per LDCT, including a report. LDCTs take place at static site scanners at South Tyneside District Hospital. Follow-up CTs for nodule surveillance are covered as part of the block contract for the radiology department. A LDCT report is given by a thoracic radiologist who is the lung cancer multidisciplinary team lead. Historical imaging is available to compare. A positive scan is a suspicious lesion or a growing nodule. Volumetry is used for nodule measurement. Nodule follow-up is as per British Thoracic Society guidelines,<sup>8</sup> and interval scan details are included in the report. A false positive was any individual seen in the one-stop clinic who was not diagnosed with cancer.

## RESULTS

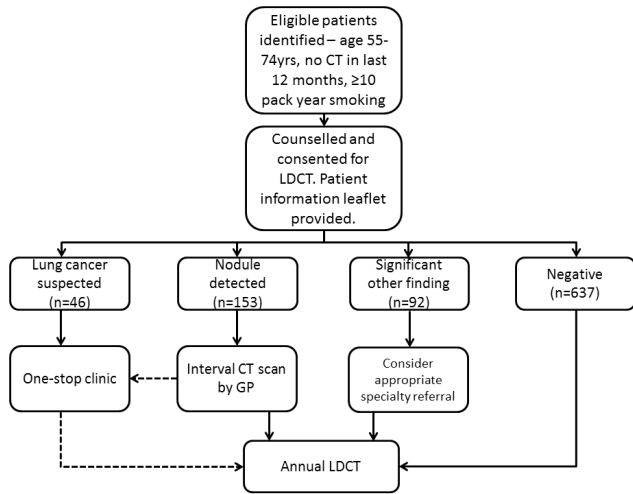
From February 2017 to October 2019, 925 individuals attended for LDCT. Data regarding those patients eligible for LDCT but declining the invitation are unavailable. 68.9% had a negative LDCT ( $n=637/925$ ). 5% of individuals had a positive LDCT ( $n=46/925$ ) and were seen in the one-stop clinic. The false positive rate was 2.4% ( $n=22/925$ ) of all individuals who had a LDCT. One died suddenly prior to review and four are still pending interval imaging for ground glass nodules. Investigations performed for participants who were not diagnosed with lung cancer included staging CT scan ( $n=19$ ), positron-emission tomography (PET)-CT ( $n=4$ ), bronchoscopy ( $n=8$ ), CT-guided biopsy ( $n=1$ ) and mediastinal biopsy for anterior mediastinal mass ( $n=2$ ). One patient had surgery for benign disease. There were no complications from surgery or investigations. Lung cancer prevalence was 2% ( $n=19/925$ ), with 21 cancers overall as two patients had two lung cancers detected. Participant and cancer characteristics are detailed in table 1. Pathological types included adenocarcinoma and squamous cell, with six tumours having a clinical diagnosis without histological confirmation. Stage of cancers was as follows: stage I 61.9% ( $n=13/21$ ), stage II 4.8% ( $n=1/21$ ), stage III 28.6% ( $n=6/21$ ) and stage IV 4.8% ( $n=1/21$ ). The surgical resection rate was 15.8% ( $n=3/19$ ). 36.8% had stereotactic ablative radiotherapy (SABR;  $n=7/19$ ), with one awaiting SABR referral, and 21.1% ( $n=4/19$ )



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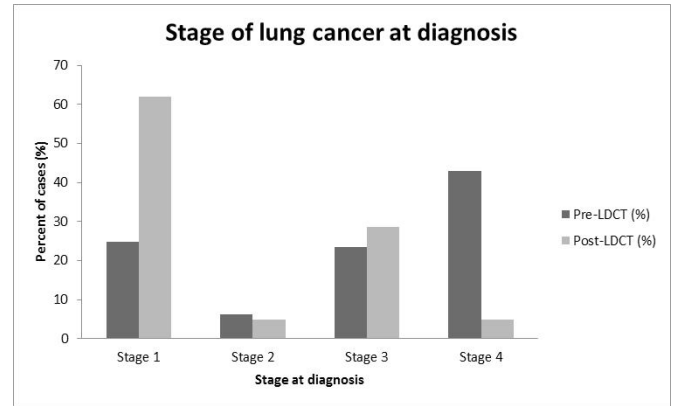
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**Figure 1** Participant journey through the lung cancer targeted screening programme. LDCT, low-dose CT.

had concurrent chemoradiotherapy. A curative intent treatment was offered in 78.9% (n=15/19). In all treated patients there were no deaths within 90 days. 16.5% of LDCTs had a nodule or inflammatory change (n=153/925). Of these, 7.2% were referred to the respiratory team for ongoing surveillance (n=11). GPs requested and acted on follow-up CT scans appropriately in 89.4% (n=118/132). 9.6% (n=89/925) of reports suggested another respiratory disease (ie, interstitial lung disease or bronchiectasis). Two breast cancers were diagnosed and one



**Figure 2** Stage of lung cancer at diagnosis: National Lung Cancer Audit 2016 South Tyneside compared with low-dose CT (LDCT) programme.

pancreatic lesion considered benign.

**DISCUSSION**

We report a novel NHS-commissioned service targeting individuals attending annual COPD review. The prevalence of lung cancer is similar to UK Lung Cancer Screening; however, it is lower compared with targeted Lung Health Check (LHC). The overall shift was towards lower stage disease (see figure 2), although there is bias comparing this selected group with an unselected group as the historical control. The rate of surgical

**Table 1** Clinical details of detected lung cancer

ID	Age	Sex	PS	Pack years	TNM	Stage	Pathology	MDT	Treatment
1*	68	F	1	15	cT1aN0M0	IA	Lepidic adenocarcinoma	Reduced lung function	SABR
2*					cT2aN0M0	IA	Clinical	Reduced lung function	SABR
3	74	F	1	41	pT1bN0	IA	Adenocarcinoma – acinar		Surgery
4	66	M	1	52	cT1bN0M0	IA	Clinical	ILD	SABR
5†	65	F	1	34	cT1bN0M0	IA	Squamous	Reduced lung function	Radical radiotherapy
6†					cT1aN0M0	IA	Clinical	Reduced lung function	SABR
7	74	M	1	10	cT1bN0M0	IA	Clinical	Site – unable to biopsy. ILD	SABR
8	60	M	3	45	cT1cN0M0	IA	Clinical	Site – unable to biopsy. Multiple comorbidities	SABR
9	70	F	2	43	cT1bN0M0	IA	Clinical	Multiple comorbidities	SABR referral
10	74	M	2	28	cT2aN0M0	IB	Adenocarcinoma	Reduced lung function	SABR
11	67	M	1	45	pT2aNx	IB	Adenocarcinoma – solid		Surgery
12	72	M	1	100	cT2aN0M0	IB	Adenocarcinoma	Multiple comorbidities	SABR
13	71	F	1	55	cT2aN0M0	IB	Adenocarcinoma	Multiple comorbidities. Site – unable to biopsy or give radical radiotherapy or SABR	Palliative radiotherapy
14	74	F	0	22	pT3N0	IIB	Adenocarcinoma – acinar		Surgery
15	60	M	1	80	cT4N0M0	IIIA	Squamous		Concurrent chemoradiotherapy
16	67	M	1	75	cT2N2M0	IIIA	Adenocarcinoma		Concurrent chemoradiotherapy
17	68	F	1	10	cT4N1M0	IIIA	Adenocarcinoma		Sequential chemotherapy +CHART
18	65	F	1	63	cT3N2M0	IIIB	Adenocarcinoma		Concurrent chemoradiotherapy
19	66	M	0	50	cT4N2M0	IIIB	Adenocarcinoma		Concurrent chemoradiotherapy
20	62	M	1	51	cT3N3M0	IIIC	Adenocarcinoma		Palliative Immunotherapy
21	64	M	0	52	cT3N2M1c	IVB	Squamous		Palliative chemotherapy

\* cancers in the same patient

† cancers in the same patient

ILD, interstitial lung disease; MDT, multidisciplinary team; PS, performance status; SABR, stereotactic ablative radiotherapy; TNM, tumour node and metastasis (8th edition).

resection is lower and this may reflect the fact that individuals had lower lung function and higher rates of comorbidities (see table 1). There was a high use of SABR, and this is an appropriate radical treatment for these individuals. The mortality rate for those screened in the first 12 months was only 4.6%, hopefully mitigating overdiagnosis in this otherwise comorbid group. GPs have engaged well with nodule follow-up.

A driving factor from the CCG was the level of deprivation and health inequalities for the area. In this group, 79.3% were in the most deprived quintiles (English Index of Multiple Deprivation 2015). Despite the concern that other screening models have a healthy volunteer effect, these individuals are mostly from the lowest socioeconomic status, suggesting this model includes those most at risk from health inequalities.

Although taking individuals with COPD and emphysema may be an appropriate group to target, the sample size is too small to assert this. Using the annual COPD review appears to be an efficient use of the service, but further work is needed to address missing data regarding uptake of LDCT invitation. Smoking cessation, psychological impact and health economics are other aspects of the ongoing study evaluation.

NHS England has announced plans for targeted LHC in 10 CCGs across the country, which would include LDCT,<sup>9</sup> and we eagerly await the results. In the meantime, we will continue our current model. We have demonstrated that this can be established within routine NHS clinical practice engaging individuals from deprived areas with a lung cancer prevalence of 2% with improvements in stage of disease.

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